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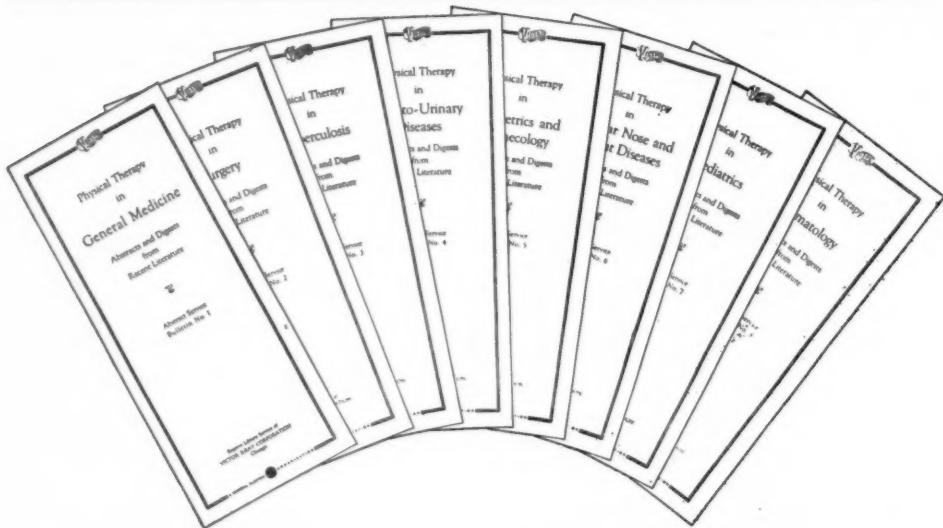
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ARCHIVES OF PHYSICAL THERAPY, X-RAY RADIIUM

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No. 4

THE EFFECT OF ULTRAVIOLET RAYS IN EXPERIMENTAL RICKETS WITH STUDIES ON THE LIME DEPOSITING CAPACITY OF THE LIGHT*

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COPENHAGEN, DENMARK

The most of the excellent investigations forming the basis of the observations referring to the relation between light and rickets, have come to Europe from America. I hardly need remind you of names like Hess, Unger, Pappenheimer, Steenbock, Weinstock and with regard to the experimental rickets above all McCallum, to prove that this is the case. Recently, among others, the name of Hess has been connected with the epochmarking proof that by irradiation with ultraviolet rays an organic substance which originally is ineffective towards rickets may be converted into a very effective antirachitic substance, which taken in trifling small doses per os, appears to have quite the same effect as the universal light bath. I shall not tire you by giving a lengthy historical description of all these extremely interesting and important circumstances. I shall assume that this is known by all my audience and shall, therefore, quickly pass over to our own investigations on some circumstances belonging here, which probably are of importance to explain the effects and modes of action of the ultraviolet rays which are in many respects even still little known. All puzzles as to the therapeutic importance of the ultraviolet rays are far from being solved by the discovery of the effects of the irradiated ergosterol.

It may be considered as acknowledged by everyone that the effect of the light and of the irradiated ergosterol on rickets and diseases related thereto is in connection with a resuscitation of the mineral metabolism which with these diseases has for some reason or other been defective. I am thinking chiefly of the phosphorus and calcium metabolism. By the term "diseases related thereto" I am not only thinking of tetany, where the light bath has proved itself as being of great effect, but also other more distant lying diseases such as bronchial asthma and vasomotoric rhinitis in which often a defective metabolism of lime can be proved, may sometimes be favorably influenced by the light bath. In this connection I need only remind you of the wonderful results which Hollender and Novak attained on this latter disease.

What is the effect of this light bath on the mineral metabolism? We have, in our laboratory, made numerous experiments for several years on this. I shall commence by speaking about a larger series of such, which my collaborator, Dr. P. Schultzer, has made. The experiments were made on black and white pied rats. (This is the same subject animal which was used to such great extent for rickets experiments, also here in America, but similar metabolism tests as we made, have hardly been made here, and they seem to me to command very

*Read at seventh annual meeting, American College of Physical Therapy, Chicago, Oct. 12, 1928.

great interest.) The experiments were performed as ordinary metabolism tests in such a manner that within a certain period of the experiment it was ascertained exactly how much the animal received in form of food calcium and phosphorus and how much of these substances pass off again in their faeces and urine within the same time the animals are placed under the treatment, the effect of which on the phosphorus or calcium metabolisms one is about to be examined. As said above it is chiefly McCallum in America who has worked with experimental rickets and who has named exact forms of food, which on being given to young rats can cause a disease of the bones which in its pathological-anatomical aspect cannot be distinguished from human rickets.

The food which our rats have received in these metabolism tests to produce a defective mineral metabolism, was prepared after the forms of food indicated by McCallum. It appears from this that when young rats are given a food which actually fulfills certain conditions necessary for the production of rickets in rats, rickets will be produced partly by rendering the quantity of phosphorus low in proportion to the quantity of lime, partly by rendering the quantity of lime low in proportion to the quantity of phosphorus. We can thus speak of a rachitogene phosphorus poor food and a rachitogene lime poor food. It is a known fact which has been ascertained by all investigators that rats in which rickets is produced with these forms of food may be cured by one of three methods: (1) the mineral contents of the food may be improved, thus more phosphorus in the phosphorus poor food and more calcium in the lime poor food may be given; (2) the animals may be given ultraviolet rays light bath and (3) they may be given pure cod liver oil, or what here in this instance is the same, irradiated ergosterol. Do all these three methods have the same effect on the mineral metabolism in their curative action or can differences be proved?

Schultzer first examined how the ultraviolet irradiation acted. Time is lacking to carefully go through the test table. I would refer anyone having a special interest therefore to the

original works and shall only speak of the results. By this means it was found for the first time that if there was a really good balancing of the phosphorus and the calcium in the food and this was not rachitogene, the light bath had no effect on the metabolism. In this case just as much phosphorus and calcium was retained in the growing rat organism whether it received a light bath or not.

In the experiments with the rachitogene food it was found as only natural that more calcium and phosphorus was retained by the light bath than when the animals have rickets. However, the interesting problem was: Does this occur because more is absorbed from the food or because less of these substances are eliminated in the urine and the faeces?

Under the action of the light bath it was observed that the intestine absorbed more of both phosphorus and calcium. If, for example, we gave the phosphorus-poor rachitogene food together with a light bath, the cure was effected by the organism being forced to absorb more phosphorus from the intestine of the extremely small quantity of phosphorus contained therein. With the increased absorption of phosphorus there is also an increased lime absorption. If we gave the calcium-poor rachitogene food, the light bath also here has the effect that the intestine is forced to absorb more lime from the extremely small quantity of lime in the intestine. The animals become by this means able to utilize almost the whole of the lime contents of the food, which they would not be able to do without the light bath.

If the balancing of the phosphorus and the calcium in the food was not the best, but neither so unfavorable that the animals got rickets, the light bath had also a beneficial effect on the resorption, while, as just said, the light had no influence in the case of fully the best mineral balancing in the food.

The same influence on the phosphorus and lime resorption which the light bath has, was also found by the administration of cod liver oil. It was not possible here to show any difference if the cod liver oil was administered in suitable doses.

But the conditions were quite different when the cure of the rickets was performed by improving the proportion of minerals in the food. It was chiefly the retained proportion of lime which showed differing figures. This was observed in the experiments at which an increased quantity of phosphorus was added to the phosphorus-poor rachitogene food. Hereby we attained an increased phosphorus resorption by the intestine but there was not, as with light and cod liver oil experiments, an increased resorption of lime. If the animals retained more lime with the increased administration of phosphorus, it occurred because they eliminated considerably less lime, particularly in the urine.

This circumstance seems to me to be of very considerable interest. When we are speaking of defective mineral metabolism, for example calcium metabolism, it is obviously not immaterial that we attempt to remedy this by giving mineral substances in the food or by giving light baths. Even if a cure occurs in both instances, the organism can behave differently in the two cases. It is not at all certain that in the two instances the cure is equally effective. The very interesting results which Hollender and Novak have obtained by different treatment of asthma and vasomotoric rhinitis seem to quite support this. One may perhaps for some time improve with lime or medicinal treatment but the most lasting cure we obtain by light treatment. It evidently improves the capacity of the organism to retain the mineral substances in a manner quite differently effective and lasting than one is able to do otherwise.

I shall therefore enumerate our experiments referring to where the rachitic effect lies in the ultraviolet spectrum and to discussing the observations, which these examinations caused otherwise.

The investigations on the effect of the various wave lengths on rickets fall into line with the most of the investigations, which I have spoken about in a previous paper. As I have remarked it may be considered as proved that the luminous rays of light have no effect on rickets; I myself was able in 1923 together with Schultzer to prove this. All authors agree that

the effect is exclusively due to the ultraviolet rays.

When Hausser and Vahle in 1925 came out with their erythema curve in which they proved that it was especially the rays between about $320\mu\mu$ and $280\mu\mu$, which were effective in the appearance of the erythema, one was immediately inclined to believe, that within this range the biological and therapeutic effects were to be found exclusively and the name "Ra" rays rickets (rachitis) was sent out for this range of rays. As shown in a preceding paper, the effects of the biological rays, which I have been able to examine, by no means have their maximum within this range. The maximum lies at various points according to the various kinds of light reaction. But where lies the effective range of rays for rickets?

The experiments which previously have been made for answering this question were made with the aid of various light filters, which absorbed different, more or less, large parts of the spectrum so that there could only be a question of the effect of the rays which passed through the filter. Now the case is so that we have light filters which only let luminous rays pass through or only luminous rays of certain wave lengths, but we have only to a very defective degree filters which exclude all luminous rays and only let the outer ultraviolet rays pass through, and no filters at all which let any part of the ultraviolet spectrum and only this pass through. Only if one has a spectral apparatus with quartz prisms and quartz lenses which are large enough to yield so powerful ultraviolet rays that an irradiation with a single line has any effect on rickets, has one the possibility of solving the question in a satisfactory manner: Where in the ultraviolet spectrum lies the antirachitic effect?

As mentioned in a preceding paper we are, at our laboratory in possession of a powerful spectral apparatus. Even if this monochromator is very powerful, probably the most powerful of its kind to be had, we were nevertheless rather skeptical to assume that the ultraviolet lines should be strong enough to have some effect on the experimental rickets in rats on irradiating

these. Fortunately, however, we were wrong in this respect, as it appears from the experiments which my collaborator, Dr. Reckling and I performed.

The apparatus is so arranged that when the line emerges from the slit in 7, which is in general adjusted to be 1 cm. high and 2 mm. wide, the rays spread much thereafter so that at a distance of 17 cm. from the slit we get an irradiated spot of 8 sq. cm. By aid of an interposed quartz prism (8) this spot can be directed into right angles with the back of the rats, which lie immediately below the prism. The spot which is formed by invisible ultraviolet rays is adjusted exactly on the back of the animal by

aid of a uranium fluorescent screen, which makes the spot visible at the moment of adjustment. The energy of the lines has of course been previously measured by a thermocolumn and mirror galvanometer, and the adjustment is performed with the known radiant energy of a hefner lamp.

It was thus found that an irradiation for a certain time with the ultraviolet lines in this manner in many instances was able to prevent rats, which were being given a rachitogene food, to get rickets. Each series of experiments with the same animals lasted 30 days, and the animals, in which the rachitic preventing property of a special ultraviolet line was examined, were

IRADDIATED RATS AND CONTROLLING RATS ON McCALLUM'S RACHITOGENE DIET NO. 3143.

Date	Litter	No.	Before	After	Weight in Gr.	Incr. in Wt. Gr.	Daily irradiated for 10 minutes with $\mu\mu$	Quantity of Energy in Gr. Calories per Sq. Cm.	Rickets	Anorganic Ph. Mg.% in Serum
26 V. bis 26 VI. 1926	35	272	43	109	66	366	$7.0 \times 0.708 \times 10^{-4}$	++	5.5	
		273	38	74	36	366	$7.0 \times 0.708 \times 10^{-4}$	+++	4.8	
		274	38	77	39	313	$4.3 \times 0.708 \times 10^{-4}$	+	3.7	
		275	42	86	44	313	$4.3 \times 0.708 \times 10^{-4}$	++	7.2	
		276	41	93	52	280	$1.0 \times 0.708 \times 10^{-4}$	-	5.5	
		277	38	80	42	280	$1.0 \times 0.708 \times 10^{-4}$	-	6.6	
		278	37	85	48	265	$1.5 \times 0.708 \times 10^{-4}$	-	7.8	
		279	40	78	38	265	$1.5 \times 0.708 \times 11^{-4}$	-	4.5	
		280	40	79	39	Contr.	0	+++	3.6	
		281	40	90	50	Contr.	0	+++	6.8	
18 VIII. bis 18 IX. '26	45	369	40	69	29	302-297	$3.0 \times 0.708 \times 10^{-4}$	-	7.2	
		370	38	65	27	302-297	$3.0 \times 0.708 \times 10^{-4}$	-	7.1	
		371	42	63	21	280	$1.0 \times 0.708 \times 10^{-4}$	-	6.8	
		372	38	68	30	280	$1.0 \times 0.708 \times 10^{-4}$	-	5.4	
		373	40	68	28	253	$1.6 \times 0.708 \times 10^{-4}$	-	5.4	
		374	42	58	16	253	$1.6 \times 0.708 \times 10^{-4}$	-	16.8*	
		375	38	82	44	200	Not Measureable	++	5.4	
		376	42	78	36	200	Not Measureable	+	5.4	
		377	42	78	36	Contr.	0	++	5.4	
		378	40	80	40	Contr.	0	++	5.5	
18 IX. bis 18 X. 1926	48	397	36	80	44	313	$4.3 \times 0.708 \times 10^{-4}$	+(+)	4.8	
		398	40	82	42	313	$4.3 \times 0.708 \times 10^{-4}$	(+)	6.6	
		399	36	72	36	302-297	$3.0 \times 0.708 \times 10^{-4}$	-	11.4	
		400	42	81	40	302-297	$3.0 \times 0.708 \times 10^{-4}$	-	9.5	
		401	40	78	38	253	$1.6 \times 0.708 \times 10^{-4}$	-	10.6	
		402	35	76	41	253	$1.6 \times 0.708 \times 10^{-4}$	-	9.5	
		403	35	72	37	227-220	$0.4 \times 0.708 \times 10^{-4}$	+++	4.3	
		404	40	75	35	227-220	$0.4 \times 0.708 \times 10^{-4}$	+++	3.6	
		405	48	77	29	Contr.	0	++	5.5	
		406	28	58	30	Contr.	0	+++	4.5	
		407	38	68	30	Contr.	0	+++	3.6	
15 XI. bis 15 XII. 1926	69	554	42	71	29	248	$0.7 \times 0.708 \times 10^{-4}$	++	4.0	
		555	35	58	23	248	$0.7 \times 0.708 \times 10^{-4}$	+	5.4	
		556	43	69	26	239. ^o -237. ^o	$0.55 \times 0.708 \times 10^{-4}$	++	5.5	
		557	35	63	28	239. ^o -237. ^o	$0.55 \times 0.708 \times 10^{-4}$	++	5.7	
		558	40	74	34	Contr.	0	+++	3.0	
		559	36	56	20	Contr.	0	+++	2.2	

*The exceptionally high phosphorus figure is in this case probably caused by a fault in the analysis.

irradiated with the same line daily for 30 days, each day for 10 minutes. After the 30 days the animals were killed and dissected. The diagnosis rickets was made macroscopically after the pathologic-anatomical findings: Thickening of the transition of the ribs into the costal cartilage, or fractura costae and broad irregular epiphysis line in the upper part of the tibia, together with a general softness of the bones. Furthermore the quantity of phosphorus soluble in acid in the blood serum was ascertained as this is abnormally low in rickets. The degree of the disease was characterized with + for slight rickets, ++ for medium acute rickets and with +++ for acute rickets. The results of these tests you see on this table.

You see that all animals, namely the animals which at the same time had received the food, but without being irradiated, as was to be expected, got more or less acute rickets. If we now go through the effects of the various lines individually, we see as follows: The line 366 had, notwithstanding its comparatively considerable energy, no effect at all. Neither the next following line, 313, had any reliable effect, but a long series of lines following, namely 302, 297, 280, 265, and 253 have had an excellent antirachitic influence. First 248 had a doubtful effect, and the lines lying still farther out, the lines about $240\mu\mu$ and $220\mu\mu$ had no effect at all. These latter lines from 248 and outward are, however, extremely weak and possibly the reason for their defective effect is to be sought in this circumstance. You see in the last column that a low appearance of rickets with irradiation corresponds very nicely to a higher phosphorus figure in the blood. The quantity of energy employed per square centimeter of the spot irradiated is given in the broad column. It appears clearly from there, what very small quantity of energy is sufficient to attain such an antirachitic effect in such experiments. For comparison the quartz mercury lamp generally used by us, the so-called "artificial alpine sun" at the general distance of 1 meter, emits, over 200 times as much ultraviolet energy as in our experiments the extremely effective line $280\mu\mu$ dose.

It clearly appears from these experiments that the antirachitic effect of the various light waves will begin, as generally assumed, a little below $300\mu\mu$ in the spectrum but that it goes much farther out than one previously was inclined to think. It goes much beyond the spectrum of the sun, and even the line lying so far out as $253\mu\mu$ is still of very powerful effect. To speak of a specific "Ra" radiation of that part of the spectrum, which lies between $313\mu\mu$ and $290\mu\mu$ hereafter seems quite unjustified. As I stated, the rats at these experiments were irradiated just as long a period with the various lines without regard to the energy being different at the lines. It is therefore not possible from these experiments to say anything definite where in the spectrum the effect is greatest and to express this in other words, what line acts with the smallest amount of energy emitted. My collaborator, Dr. Reckling has for some time been engaged in an investigation but such titrating experiments are of course very tedious and demand very long and comprehensive series of experiments. Before I come to these, I must in the meantime speak about a very peculiar circumstance in this antirachitic irradiation which Dr. Reckling and myself had to first overcome before we could start titrating the activity of the various wave lengths. The rats which we used for the experiments I have just spoken about, were fully covered with hair, and here where the irradiation was so weak and where notwithstanding ultraviolet lines lying very far out could also have a curative effect at their extremely small penetration power, we were at first quite without an explanation for this phenomenon. The fur on the back of the rats is very close and thick. In advance one must think that the energy of the lines as 265 and 253 will be immediately absorbed by the coat of hair and not reach down to the skin at all, not to speak of into the organism.

There seemed no other possibility than to assume that if these lines actually had an excellent effect, it could not be because the energy of the rays was directly absorbed by the skin, but because substances in the fur were influenced and when afterwards the animals licked themselves, they took the substances rendered

antirachitic by the irradiation per os. In order to see whether this really was the case, Dr. Reckling made some experiments, at which the rats were absolutely prevented from performing the natural cleansing of their fur. Naturally this was a very difficult thing and many different experimental arrangements were considered until he at last adopted a certain method, which however, also has been the subject of several improvements.

Nelson and Steenbock have previously made the curious observation, that when a number of rats were placed into the same cage, all with the same antirachitic food, and the one half of

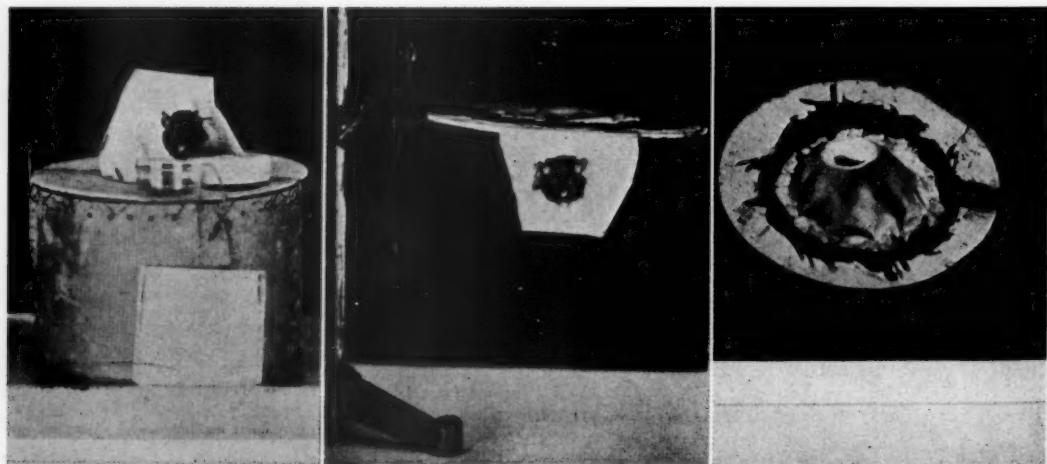
Steenbock as to the cure of the non-irradiated animals was right, appears from this experiment, where two rats of the same litter had lived together in the same cage, and only the one was irradiated. Neither developed rickets but two controlling animals, which were not irradiated, both got rickets.

At these experiments there could also be a question of an effect through the excrements from the animals irradiated, but at the experiments with irradiation with the individual lines, there could not be the question of anything like that. For proving as I have mentioned, whether there were substances in the fur that had become

RATS ON McCALLUM'S RACHITOGENE DIET NO. 3143.						Anorg. Ph. in Serum Mg.%
Litter	No.	Weight at Begin Gr.	End Gr.	Inc. in Weight Gr.	Addition	
37	289	37	68	31	10 min. daily irrad.	+
	290	34	77	43	in cage with 289	+
	291	35	73	38	10 min. daily irrad.	+
	292	34	75	41	in cage with 291	+
	293	38	75	37	10 min. daily irrad.	+
	294	35	68	33	in cage with 293	+
	295	36	83	47	10 min. daily irrad.	+
	296	40	92	52	in cage with 295	+
	297	42	102	60	Control animal	++
	298	45	92	47	Control animal	+++

these rats were irradiated with ultraviolet rays, not only these but also those not irradiated in the cage were free from rickets. The investigators thought that it was the excrements of the animals irradiated which the non-irradiated animals ate, that had received antirachitic properties. That this observation by Nelson and

antirachitic and acted per os the young rats were placed into a kind of hood of batist which was so arranged that the head of the irradiated body never came into the same chamber after the irradiation had been commenced. A round wooden frame was made, to the inner edge of which the edge of a batist bag was fastened,



so the whole resembled a hat with a stiff rim and a soft crown. In the batist there was made a hole the size of a dime to the rim of which was fastened a thin rubber tube with a copper wire which was fastened so tightly around the neck of the rat with its head outside of the bag, that the rat could not draw its head through. With this hood the rat was placed on a steel wire netting.

These experiments have mostly been made as a kind of curing experiment so as not to have the rats too long in the inconvenient hoods. For the first fourteen days they were fed the rachitogene food and the following fourteen days were irradiated every day for five minutes from

substance per os and this is able to develop its antirachitic effect. It may be considered as given that in all rat experiments published over the whole world with light treatment of experimental rickets it was essentially a matter of such an effect per os through the influence of the activated grease of the skin.

Involuntarily the question is put: Can light have any effect on rickets by irradiation of the skin directly through the latter? Children always have the tendency of sucking and licking their fingers. Could these small quantities of grease from the skin, which come into question in curing rickets per os, come to the child by its touching or scratching the irradiated

RATS ON McCALLUM'S RACHITOGENE DIET NO. 3143.

Litter	No.	Weight			Wt. Difference 15-28 days Gr.	Additionally for the last 14 days	Anor. ph. in serum Rickets mg.%
		Begin Gr.	14 days Gr.	28 days Gr.			
70	560	42	63	55	÷8	5 min. daily irrad. in "hood"	+ (+) 4.1
	561	46	60	57	÷3	5 min. daily irrad. in "hood"	++ 3.0
	562	46	64	55	÷9	5 min. daily irrad. in "hood"	++ 3.9
	563	45	75	65	÷10	5 min. daily irrad. in "hood"	++ 2.8
	564	47	65	57	÷8	Control animal in "hood"	++ 2.7
	565	46	62	*1		Control animal in "hood"	++
	566	44	57	51	÷6	0.10 gr. cod liver oil daily in "hood"	÷ 5.1
	567	42	57	**2		0.10 gr. cod liver oil daily in "hood"	÷
	568	45	59	63	+4	5 min. daily common light bath	÷ 5.9
	569	43	52	52	0	5 min. daily common light bath	÷ 5.7

*After five days in the "hood."

**After eight days in the "hood."

a quartz mercury lamp at a distance of 1 meter which according to our experience was always sufficient for a cure. As you see here on the table the animals irradiated just as well developed rickets as the controlling animals in the hood which were not irradiated. That it is not the "hood process" in itself that gives the rickets, may be seen by the fact that the hooded animals who daily got a dose of cod liver oil, did not get a trace of rickets. Rats which receive the same light bath but in the usual manner without the "hood" are cured promptly. The other experiments give the same results, also experiments where the rats in the hood are irradiated with the individual lines. It may thereafter be considered as proved that the rats eat, if we may say so, the light bath into themselves. The grease of the skin on the hair, which certainly contains much ergosterol becomes antirachitically active by the light bath. When the animals lick themselves they take the activated

parts? At all events it was impossible in advance to exclude that this was the case.

It is of course impossible to fix the rachital children in a batist bag with the body inside and the head outside during the days or weeks which they receive the light bath. Neither was it possible to tie the hands of the children so that they could not reach their mouths. Should the question be solved it could only be done by experiments on rats.

The experiments were then made on depilated rats arranged in hoods. Before the animals were fixed in the hoods, they were by aid of a paste of barium sulphite completely freed of all hair on their backs. The irradiation was thereafter continued for fourteen days on the naked skin of their backs.

Many corresponding experiments have been made. It is shown here that the animals which

are in the hoods during the irradiation, but are depilated, were entirely free from rickets, whereas the non-depilated in the hood, the same as in the preceding experiment acquire rickets quite the same as the control animals in the hood which are not irradiated. Animals in the hood which receive cod liver oil are cured, the same as animals irradiated but without hood and without depilation.

Hereby it is shown that the ultraviolet rays also can act directly through the skin, and it is therefore reasonable to assume that the action of the light bath on human rickets actually is due to the action of the rays on substances within the skin.

But with experimental rat-rickets the light can act in two ways, partly per os if we may

example by aid of the phosphorus soluble in acid in the serum of the rats. But notwithstanding the greatest care being taken in rendering the first food for all young rats before the experiment the same, and the food of the parents made uniform for generations, it is not possible to get the phosphorus figures in the serum with the various litters of rats to correspond to each other quite exactly. The phosphorus figures which with one litter of rats are not found with rickets may with another litter be found as a sure sign of rickets. In order to obtain a uniform judgement of the effect of light on the various litters it was necessary to use another means of measuring for rickets. When the light cures rickets, it is among other things due to lime being deposited on the bones. For examining the degree of the rickets or of the cure, Dr.

YOUNG RATS ON McCALLUM'S RACHITOGENE DIET NO. 3143.

Litter	No.	Weight				Wt. Diff.		Daily addition in 14 of the last 16 days of experiment	Anorg. ph. in serum	
		1 Gr.	15 Gr.	30 day Gr.	days Gr.	15-30 days Gr.	1-30 days Gr.		Rickets	mg.%
75	601	46	69	61	8	15		depilated, 5 min. daily u. v. in "hood"	÷	8.5
	602	44	62	55	7	11		depilated, 5 min. daily u. v. in "hood"	÷	7.9
	603	50	71	61	10	11		5 min. daily u. v. irrad. in "hood"	+(+)	3.2
	604	40	60	56	4	16		5 min. daily u. v. irrad. in "hood"	+	3.7
	605	50	73	69	4	19		Control animal in "hood"	++	2.4
	606	46	67	59	8	13		Control animal in "hood"	++	4.7
	607	42	72	62	10	20	0.10 gr. cod liver oil daily in "hood"	÷	6.0	
	608	43	75	68	7	25	0.10 gr. cod liver oil daily in "hood"	÷	6.7	
	609	39	57	65	8	26	5 min. daily u. v. irrad.	÷	6.9	
	610	45	62	72	10	27	5 min. daily u. v. irrad.	÷	6.5	

say so, and partly directly through the skin, the latter, however, only when the fur has been depilated.

As I said before it was originally the task to titrate the antirachitic effect of the different ultraviolet lines in proportion to the energy of the lines. The experiments showing the two different actions of the light with experimental rat rickets, make it naturally necessary that such titrating experiments are above all made with depilated animals. It goes without saying that this mode of action demands the greater clinical interest. However, soon another difficulty was met with. The titrating as is here under question, with a varied quantity of energy with the same lines, demands experiments with many litters of rats. If it is a matter of one single litter, it is somewhat safe to judge the possible different degrees of the rickets in animals, for

Reckling began analyzing the contents of lime and water in the tibia of rats. Time is lacking to prove the advantages of this method. I shall only give you an example, how the titrating has resulted in doing so. After a certain number of experiments with irradiating depilated animals, he chose the percentage of calcium found in the bones at a daily irradiation for 15 minutes with $300\mu\mu$ in fourteen of the last sixteen days of the experiment as starting point and basis for comparison for the irradiations which took place with other lines for different times.

In this table is shown a litter of eight young rats of which two were irradiated with $300\mu\mu$ for fifteen minutes, two with $265\mu\mu$ for ten minutes and two with $265\mu\mu$ for 20 minutes and two are control animals. It may be seen clearly that the animals which have received an irradiation for twenty minutes with $265\mu\mu$ have a

larger content of calcium in their bones than the animals which had been irradiated for only ten minutes. This proves that the lime depositing capacity of the light is dependent on the quantity of energy irradiated. Furthermore you see that the quantity of calcium which $300\mu\mu$ is able to deposit at an irradiation of fifteen minutes approximately corresponds to the quantity which $265\mu\mu$ deposits at ten minutes irradiation. As the proportion of the caloric energy of $300\mu\mu$ and $265\mu\mu$ is 2.8 to 2.1, there follows therefrom that $265\mu\mu$ in the light consumed has a larger specific lime depositing capacity than $300\mu\mu$ which has previously been considered as having the greatest capacity in this direction. These titrating experiments are not yet closed, but it appears as if it will be the line $280\mu\mu$ which

depositing power of the light. In Denmark, there has recently been some discussion on what should be considered as rickets, especially which criterions we should have to be able to recognize that the so-called experimental rickets is really rickets. There is hardly any reason to go deeply into this here. I shall only point out that rickets must be considered as a growing disease, and it is a condition for the human rickets to develop that the animal is growing. In a part of Dr. Reckling's experiments, the rats which were arranged in the hood were arranged in a manner particularly unfavorable for their thriving, but kept the same weight during the experiment or lost a few grammes sometimes. They then acquired what could be called an osteoporotic rickets. The peculiar

YOUNG RATS ON McCALLUM'S RACHITOGENE DIET NO. 3143.

No.	Irrad with Line	in Min.	Rickets Macroscopy	Anorg. ph. in Serum mg.%	Percentage of Calcium in bones Moist	Dry	Percentage of water in bones
1015	$300\mu\mu$	15	None	8.0 7.8	7.6 7.7	14.5 14.8	47.6 48.2
1016	$300\mu\mu$	15	None	7.7	7.8	15.2	48.8
1017	$265\mu\mu$	10	None	6.7 7.5	7.8 7.8	15.1 15.3	47.9 47.9
1018	$265\mu\mu$	10	None	8.3	7.9	15.5	47.9
1019	$265\mu\mu$	20	None	7.2 7.2	8.7	16.1	46.1
1020	$265\mu\mu$	20	None	7.3 7.2	8.6 8.5	16.0 15.9	46.6 47.1
1021	Control		Medium	5.5 4.8	6.6 6.5	13.9 13.6	52.8 53.4
1022	Control		Medium	4.1	6.3	13.3	54.0

in proportion to its energy proves to have the maximum lime depositing capacity. Possibly this is connected with the fact that the ergosterol, the antirachitic activation of which in the skin-cells is assumably a consequence of the light bath, has its maximum absorption capacity just about this line. You see clearly here, that the erythema causing capacity of the light, which is strongest at $300\mu\mu$, considerably weaker but recognizable at 260 and as good as nil just at $280\mu\mu$ and the lime depositing capacity of the light, *do not cover each other*. The reason for the absence of the erythema at $280\mu\mu$ could perhaps be sought in the fact that these rays are absorbed immediately at the surface of the skin by the lipoids of the skin, whereby the antirachitic effect is produced, and therefore do not penetrate deep enough to produce an erythema.

I shall now say a few words on the lime

thing, however, was that also on such osteoporotic rickets the suitable ultraviolet rays had a correspondingly good lime depositing effect. This problem has therefore also been taken into investigation, namely in how far light has any effect on osteoporosis without the proper symptoms of rickets. Dr. Reckling did this by putting a number of young rats on food, free from vitamine A which at the same time was poor in lime, and irradiated one half of the rats for ten minutes from the commencement of the experiment. After the expiration of about one month all animals were very ill owing to the want of A vitamines and were killed. At an analysis of the lime percentage in the bones, it was found that the animals which had received light had much more lime here. In other words this says that the ultraviolet irradiation causes a lime deposit both in the rachitic and in the osteoporotic bones.

Besides the analysis of the bones, wide-reaching microscopical investigations of the bones of animals, treated and non-treated were also performed. Here the peculiar fact was noticed that notwithstanding the higher percentage of lime in the bones of the light treated osteoporotic animals the osteoporosis was rather most expressed here. The light had apparently caused a more rapid resorption of the spongyous substance whereby the cavities became still larger than without light treatment. But on the contrary it appeared that the diaphysis of the light treated animals was much thicker than with the controlling animals and here is thus the quantity of lime which the light treated animals have beyond the controlling animals.

In these osteoporotic bones the light has not been able to ossify still more enchondrally but epichondrally by apposition to the bone. The reason for the wanting enchondral ossification is just therein that the light has no material to work with, as the cartilage proliferation and formation of osteoblastic tissue, has completely ceased, owing to the absence of A vitamines. Only the other side of the effect of the light by the enchondral ossification can show itself, namely its tissue destroying property, the property, which if the animal had an overproduction of osteoid tissue would have shown itself by bringing order into the zone of growth by depositing lime in the proliferated cartilage cells. If osteoporotic rats, as are spoken about here, are given a small quantity of A vitamines, the symptom of A-want can be removed, that is to say among others remove the xerophthalmus and get them to grow, but if an antirachitic factor is not simultaneously given, or what would be the same, ultraviolet irradiation, the animals get rickets. The growth producing factor, which the A vitamines supply, shows itself by a violent proliferation in the cartilage and an ample formation of osteoid tissue. But the order producing, resorbing retaining calcifying factor is absent, and the animals get rickets. The supply of an antirachitic factor or the irradiation with ultraviolet light thus brings about the natural conditions. The light retains the excessive production of elements of growth, resorbs the too ample osteoid tissue, gives strength by the lime depositing and brings ordered and normal conditions on the whole.

On the whole one may say that wherever there are disturbances in the mineral metabolism, there is reason to try with ultraviolet irradiation, what besides is in accordance with the clinical experiences already made.

I think it advisable, in this connection, to remind you of the effect of ultraviolet irradiation on plants. Also here it appears as if these rays retain and regulate the growth of the plants, and make them stiff and resistant to live by themselves when they come out into the storms of life, both in a natural or in a transcendental meaning. If the plants are only exposed to luminous rays, for example only to red light, they become long, large and soft with hanging leaves. The ultraviolet rays bring in an order-producing and regulating factor. It is not without importance to witness this apparent uniformity as regards the effect of the rays at different places in nature. Wherever there is life and growth, there is not alone the pure life promoting factor of importance, but also the retaining, order producing and regulating forces are needed to place the whole onto the right spot.

I have in this paper considered it as my object to restrict myself exclusively to our experiments on the biological effects of the light, so as to thereby obtain a comprehension of the therapeutic effects. I have therefore among other things, not spoken of our purely therapeutic experiments with patients for example of surgical tuberculosis. In another paper I pointed out that the luminous rays perhaps had a good share in the favorable results which we have seen. Today I shall not omit to say, that the ideal lies not so far, that among others the calciferous power of the ultraviolet rays may also be of therapeutic importance on these forms of tuberculosis. An increased tendency of lime depositing at the parts more or less destroyed by the disease may certainly be of great curative importance. Let me close by saying that we must first of all avoid to look onesidedly on the matter, when it is spoken of forming an opinion on the valuable effects of light on the organism. All possibilities should be taken into consideration, and as far as possible, all possibilities should be investigated, each for itself.

THE USE AND ABUSE OF PHYSICAL THERAPY IN THE MANAGEMENT OF CHRONIC ARTHRITIDES*

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Physical therapy should be used only as an adjunct and not independent of accepted general measures of treatment in the management of the chronic arthritic. This implies an accurate diagnosis as well as a rational classification of the various clinical manifestations of the disease. The most frequently repeated phrase in any meeting of physiotherapists is "First, be sure of your diagnosis."

In a general way the favorable effects of physical therapy in rheumatic and arthritic manifestations are due to the influence on circulation, particularly the capillary beds, which argues for disturbed circulation as a part of the underlying pathological change. It is probable that suboxidation tends to lower tissue resistance and encourage localization of the arthritic process. It is important to apply physical therapy measures early in the course of the disease and favorable results depend in part upon the early proper application of all remedial measures. Rational management of the chronic arthritic must imply removal of and combating of all active etiological factors as well as restoration of impaired function incident to the effects of the disease.

From time almost beyond the memory of man the treatment of joint and allied disabilities has been a medical football with every known form of practitioner, cultist and faker feeling perfectly free to get into the game and so the patient, he being the football, gets kicked about until he is literally treated to death. Age old as the problem is, it still remains a serious one. My belief is that if we can reach out and recognize these cases early enough, physical therapy plus close attention to possible contributing factors both from a medical and surgical point of view, offers these sufferers their best chance of

avoiding the wheel-chair in their middle and declining years.

Even though there is a wide variation in the views of different authors on the etiology of chronic arthritis, and even though we continue to have prominent clinicians tell us that this or that pathological condition is responsible for the arthritis, and even though we are positive in our own minds that no one has yet come near a solution of the problem, we must remember that the patient is entitled to the advantage of every scrap of reliable knowledge we can gain about the condition from which he suffers. I illustrate this by pointing out one of the instances of misapplied physical therapy. Certain disabilities of the shoulder joint are due not to a subacromial or subdeltoid bursitis, but to the formation of a small area of granular degeneration in the fibres of the supraspinatus tendon. This severely limits the motion of the shoulder joint because when this area strikes the tip of the acromial process the pain is so severe that muscle spasm prevents further motion. Such a disability is frequently treated by means of physical therapy without adequate x-ray investigation, and it becomes one of the cases of which we so often hear it said, "All forms of physical therapy were tried without results." Of course physical therapy failed, because such a shoulder must be operated upon. A simple longitudinal incision splitting the fibres of the deltoid and dissecting out the area of granular degeneration, then applying physical therapy will restore the shoulder to complete function. My point being that such a patient is subjected to needless suffering if all the knowledge at our disposal is not used for his benefit.

There is much to be said about the urgency of vigorous treatment early in the course of a case of chronic arthritis in order to prevent joint deformity and hopelessly impaired joint function.

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Too often a patient is sent out with the instruction to have the teeth extracted or to have the tonsils enucleated, and we think we have rendered valuable service. But what about the suffering of the patient and the change going on in the joints while these procedures are being carried out? Or what about the after period of waiting while the patient wonders if these procedures are going to be of any help in relieving him of his distressing symptoms? Valuable time is being lost unless we proceed vigorously with treatment. Before going into just what I mean by vigorous treatment may I call your attention to some of the signs which lead one to suspect that a patient's joints are in danger. You can not always obtain a history of acute articular inflammation at some former time, but nearly always you will obtain a history of pain following acute infections particularly those of the upper respiratory tract. Then if you examine closely, you can elicit tenderness very frequently along nerve trunks, particularly along the sciatic, ulnar, median and circumflex nerves, and often many of the spinal roots. This nerve tenderness often exists long before the joints get into trouble and may be a valuable means of indicating the urgent need for careful and watchful treatment. Llewellyn and Jones describe the pathology of this nerve tenderness as being an inflammation of the fibrous elements of the nerve sheath and of the interstitial tissues. I am not referring now to those cases in which the patient complains of pain which calls your attention to the sciatic or circumflex or intercostal nerves. The tenderness I would have you look for is found along nerve trunks where there has been no pain and the eliciting tenderness is often the first indication to the patient that there is anything wrong in this location. If the early history can be carefully scanned one gets a strong impression that many of these patients have the onset of their trouble in early childhood. Frequently repeated acute infections from which recovery was slow, history of numerous attacks of the so-called growing pains and a general childhood picture of lassitude probably said by the parents to be just pure laziness.

One cannot leave this subject without reference to the psychotic element in these cases.

They complain of all sorts of bizarre and unreal symptoms which we are inclined to pass over too lightly, thinking that if the underlying pathology is attended to, the faulty mental attitude of the patient will clear up. But the patient resents this apparent indifference on the part of his physician. To him it is the most important part of his trouble and when it receives only passing notice there is an immediate break in his confidence. We must realize that such patients are in need of treatment for a prolonged period. They will continue to pass from practitioner to practitioner if we fail to show a sympathetic, kindly attitude toward that feature of their illness which is most important to them. This requires time and attention to details which from a medical standpoint seem rather trivial, but we need to remember that the final judge as to the adequacy of our treatment is the patient himself.

Hydrotherapy and its allied methods continue to hold first place as a means of arresting the progress of joint dysfunction. If, however, the symptoms of nerve trunk involvement predominate we must be careful not to advise too strenuous massage. The heat of the electric cabinet and soothing effect of the warm spray shower followed by a very gentle, general effleurage, makes an ideal initial treatment. Diathermy too is capable of doing harm if applied too strenuously in the beginning. The auto-condensation type of diathermy with a not too small electrode applied so that only gentle warmth will be felt gives the patient at his first few treatments a very grateful sense of relief. I think there is great danger in jamming a diathermy treatment right through a joint. This is especially true of joints that are well covered with fat. We must frequently remind ourselves that the heat concentrates where tissues are most dense. The condyles of the femur become points of great heat under diathermy, no matter how much fat they have over them, and fatty tissue which has been overheated by diathermy will make the patient sore in more ways than one. There are cases of course where strenuous treatment right from the start is advisable and necessary. Muscular atrophy, periarticular fibrosis and muscle spasm requires the heavy Scotch

douche type of hydrotherapy and the deep pe-trissage.

It is dangerous for the physician of an arthritic patient to fall into the habit of merely recommending an undirected program of hydrotherapy and massage. The average hydrotherapy technician is likely to run one case after another through the same routine unless under close supervision, and then, too, the hydrotherapy program needs frequent changing to suit changing condition. Infra-red radiations preceding the hydrotherapy program is of great help where the periarticular structures are causing limitation of motions. Hospitalization for this purpose is of the utmost importance and wherever possible this should be continued at least until remedial measures have had a chance to show their effect.

Lack of physical exercise has long been considered as an important factor in disease and the employment of exercise either in the form of mechano-therapy, gymnasium or properly selected games often brings prompt renewal of health. The last ten years have brought a great change in the attitude of the public and the profession toward the value of the various forms of physical therapy. The proper use of the different forms of physical therapy treatment incident to the war and subsequent to the war has been a great educational means of establishing these forms of physical therapy. Proper use of physical therapeutic measures presupposes a proper diagnosis and should be used only as an adjunct to all other rational measures of treatment. It requires team work with other branches of medicine, and individualization of use which can not be according to the rule of the thumb which has so largely characterized the use in the past. Commercialism in this field of work can be controlled finally by hospitals where well developed departments of physical therapy are supervised by well trained medical men who are not fadists. No non-medical physical therapist should have the responsibility of determining what therapy shall be applied and how that application shall be made. The treatment habit as applies to the chronically ill should be deprecated. Measures that improve circulation, increase metabolism, encourage removal of waste pro-

ducts have a beneficial effect on the disease. All physical therapeutic measures must be applied with caution and not carried to the extreme where the general health of the patient may be impaired. Undue claims of the value of such measures should be combated and the public should be educated as to the value of and limitations of such methods of treatment. The unfortunate victim of incurable chronic disease should not be uninformed as to the value of all physical therapeutic measures. For example, the laymen should know that there is no particular virtue in the chemical composition of water used for the various baths, that whatever value there is in hydrotherapy, chemical constituents of water do not enter in.

Before the application of physical therapy measures a careful diagnosis should always be made and no treatment can be made satisfactory in the hands of the unskilled and misguided enthusiast. Value of electrotherapy as represented by diathermy, galvanic and sine currents must be weighed with caution. Whatever value there may be must depend upon action of muscles, increased metabolism as a result of increased heat and increased circulation. Ultraviolet ray and infra-red ray have a place in treatment of the arthritic but it is often difficult to make results tangible. Whatever form of treatment is applied it is important to have the confidence and complete co-operation of the patient over an extended period of time. In an analysis of 140 cases of chronic arthritis treated in the last five years, the value of physical therapy measures as an adjunct in treatment has been analyzed. The problem of the chronic arthritic requires team work on the part of the internist and the physical therapist to obtain the best results.

In a series of 140 cases of chronic arthritis it must be admitted that physical therapy as applies to baths, massage, ultraviolet ray and diathermy were used with considerable disappointment in certain cases. In the whole group of chronic diseases, perhaps none are more difficult to treat than chronic arthritis, any or all forms of treatment yield unsatisfactory results in certain cases. Diathermy, while occasionally seems to have value, more often is disappointing and in the more acute manifestations seems to be

contra-indicated. In the treatment of this group of 140 cases effort was made to improve the general health and effort was made to have the patient adjust his life to the demands of the disease. A relatively low carbohydrate diet was advised in most cases with a low caloric intake in the obese. Rest, avoidance of exercise and encouragement of elimination was a routine in all cases. Drug therapy consisted of the salicylates, cinchophen, iodides, amiodoxyl-benzoate and in the obese with a low metabolic rate, thyroid extract was judiciously administered. Colonic irrigations were used as a routine. The results of treatment were as follows: Marked improvement in 19 or 14%, definite improvement in 86 or 61%. Eleven or 8% were unimproved and 14 or 10% were questionable, at times improved and then relapsed.

SUMMARY

1. On account of obscure etiology and indefinite terms of classification, we must content ourselves in many cases of chronic arthritis to treatment of symptoms.

2. Physical therapy may be misapplied and the patient's suffering prolonged by failure to make use of all possible means of learning his exact condition.

3. Valuable time may be lost by failure to start a thorough treatment program at the earliest possible moment.

4. Tenderness along nerve trunks may be an early indication of oncoming joint pathology and affords a chance of arresting the progress of the disease in time to save the joints.

5. The psychotic element in these cases must have our attention if we expect to hold the confidence of the patient.

6. Careful personal attention to the management of the treatment may mean the difference between success and failure.

7. Diagnostic routine calls for hospitalization and the initial stages of treatment should be carried on during that time.

8. Physical therapy in any or all forms can not be satisfactorily and effectively applied inde-

pendent of general management as applies to dietary, appropriate drug therapy and colonic irrigations.

9. Team work on the part of the physical therapist and internist is necessary if the unfortunate sufferer of chronic arthritis is to have the best possible management.

DISCUSSION

DR. E. E. BRUNSON (Ganges, Michigan): What would be the damage done by diathermy? I didn't understand exactly with what cases it should be used with care. I didn't think diathermy was good for that condition.

CHAIRMAN ELSOM: I think the doctor said in very acute cases. We will allow him to answer that question.

DR. J. W. TORBETT (Marlin, Texas): We who treat those chronic cases know that they are very hard to handle and that the tendency every time is to try to include everything as a type of focal infection. The doctor is very discriminating in the chronic cases, and as many of them come at the menopause, as mentioned this morning by Dr. Kern, it is a metabolic condition in many cases, and the diathermy, as mentioned in the acute conditions, will frequently make them worse.

The doses of diathermy and all other physical therapy methods should be given like a dose of medicine. They should be given for a stimulating, sedative or reactionary effect on the cellular tissue, and the dosage must be as carefully regulated as in other forms of therapy.

In speaking of dietetics, I wish to mention one thing that Dr. Pemberton as well as those who have followed out his line of work believes, that there is a low carbohydrate tolerance but does not differentiate in the types of carbohydrates. That, I think, is a very important factor in feeding these patients. The ordinary carbohydrates are acid in their reaction to the blood. There are, however, certain types of carbohydrates I find very beneficial in these cases of the ordinary so-called chronic arthritis.

Potatoes are very important items and they are allowed in cases of diabetes now. We give potatoes frequently in case of diabetes. Potatoes are seven per cent alkaline. You all remember the physician who made so many experiments in diabetes. He put a patient on potatoes and margarine for eight months. Recently that has been mentioned in the A. M. A. editorial pages. He had no soreness of muscle during that time. He had perfect strength and vigor and worked fourteen hours a day, so he says. We do not know the cause but I think it is due to the fact that the potato has a highly concentrated portion of protein in the first place, and in the second place, it has, when thoroughly cooked, a tendency to be easily

digested and assimilated as alkaline in the blood. The potato also has several mineral salts in it, making it a very important item of food.

Green vegetables and fruits also represent a form of carbohydrates that are alkaline in form and they have plenty of the so-called vitamins which are oxidizing agencies and very beneficial in this class of cases.

This line of diet along with plenty of fresh air, as pointed out by Hippocrates two thousand years ago, sunshine and heat, together with the proper enforcement of psychotherapy to avoid worry, and those other consuming passions that are worse than work are especially beneficial. Always look for a focal infection, but reflect that infection is not the deciding factor in these chronic cases by any means. There have been too many teeth and too many tonsils and too many other things taken out in this class of chronic cases that come on in the middle or older periods of life.

DR. F. H. EWERTARDT (St. Louis): It has fallen to my lot to treat arthritis for the last twenty years and after treating these conditions for so many years we find that we know about as much today as we did then, twenty years ago. It is a little bit difficult to treat arthritis, and yet, as the speaker said, probably the best outlook we have is physical therapy. His topic was the use and abuse of physical therapy, and the paper was a very interesting one.

I have picked out one or two points which I wish to bring forth, some of which I agree with and some of which I do not agree.

In order to bring out the first point I will refer to the illustration which he used, and in order to strengthen my point I want to say that my particular work in the hospital is in the orthopedic surgery department, so I speak from that viewpoint. It was shown that we never had in these past years a shoulder case failure, and I was a little discouraged when the doctor brought out a shoulder case as an illustration of his theory of the abuse of physical therapy.

He speaks of the pathology of this particular instance being granular degeneration of the infraspinatus muscle and that the operation was successful, whereas physical therapy was not. That is all right; probably it was so, but the point I want to make is this: I am afraid that using that illustration might lead to a mistaken interpretation of the use of physical therapy in shoulder cases. There are some shoulder cases, if you please, that can very successfully be treated by physical therapy measures.

I can say that in our number of cases and we have had several hundred, that the percentage of operations was certainly less than five in these shoulder cases, and they included the deposit of lime salts. There are some surgeons who prefer to operate when there is a deposit of lime salts, and others who believe

the application of heat will cause the lime salts to disappear. I belong to the latter school.

To come back to my point, I hardly believe that the speaker intended to convey the idea that physical therapy was not to be used in these shoulder cases. The point he wanted to make, I believe, is that we must make a very careful differential diagnosis. It is very difficult to make a differential diagnosis between the conditions cited, and just a tendon strain, and if we were to operate on all tendon strains showing a deposit of lime salts in the surrounding region I am afraid we would have to do a lot of operating.

I quite agree with the doctor that after we make a clear diagnosis it is probably well to operate.

The other point that I noted was with regard to the use of massage. He mentioned that in muscle spasms a vigorous massage was indicated. That has not been my experience. I believe that the Scotch douche hydrotherapy is one of the most important factors in the therapy treatment of arthritis. I do believe that better results can be obtained so far as massage is concerned by using a lighter rather than a heavy petrissage. I do believe it is worth emphasizing. Wherever we are going to use massage in the removal of spasms it should be very light and tender and general rather than heavy.

I was very glad to see that he brought out points that I heartily agree with. He speaks of the value of hydrotherapy. I have used it for twenty years and I would not be without it. I was asked to lay out a physical therapy department for a new hospital recently and they asked me which was the most important, and I thought if they would take my Scotch douche away from me they would take one of the most valuable pieces of equipment I had. That, I believe, in conjunction with the judicious application of heat, is tremendously important for the upbuilding of the general health, and that is I think, the foundation of the treatment of arthritis.

I should like to bring out this point: He said, and I agree with him, that too many people use physical therapy to treat the arthritides, and they use other methods and get nowhere. I know that to be a fact. To use diathermy or hydrotherapy, it has to be done correctly, otherwise you are not going to get results.

In connection with that I should like to bring out this idea: One of the main abuses of physical therapy is performed in the doctor's office by the office girl. I know what I am talking about when I make that statement.

Last week before I left St. Louis I had two requests from doctors asking me whether I would not allow his girl (that is, in each case his particular office girl who is doing a little minor nursing, or I might call it his first aid) to come to my department

and take physical therapy for two weeks so that they might better be able to carry on the work in his office.

We talk about the manufacturer, that he injures the cause of physical therapy; the fellow who injures the cause more than anybody else is the doctor himself.

DR. L. S. BROOKHART (Cleveland): I am awfully glad that Dr. Ewerhardt brought up the subject of shoulder cases. I realize that he is going through very much the same experiences that most of us have had in that the disabled shoulder is a very serious problem.

The doctor did misunderstand a little bit about the particular condition that was brought out in this paper. That is, when we have an area of granular degeneration in the supraspinatus tendon, and it has reached a sufficient degree of degeneration, physical therapy does fail, but that does not detract from the immense value of physical therapy in many other cases of shoulder joint disability.

In the initial diagnosis I think it is not so difficult. Most x-rays of shoulder joints for shoulder disabilities as such, as taken with the arm to the side and the direction of the tube will never show the condition that I refer to.

If the arm is put in complete abduction like this and the direction of the tube is so made that the rays will penetrate at an angle rather than directly, we will get a little semilunar shadow clear outside the joint where it might be considered a granular condition, that is the condition that I refer to in this discussion. If we try to dispose of such a condition by physical therapy alone we are going to be disappointed. I

mention that point merely to show that sometimes even in the immensely valuable practice of using physical therapy on shoulder joints it might be misapplied.

I was very glad indeed to have the doctor bring out this subject of diet and differentiation between the different forms of carbohydrates. The very subject of diet makes us realize that the gastro-intestinal tract is too often overlooked as a cause for or a probable cause at least for the cases of chronic arthritis.

The acid-forming kind of carbohydrates, of course, must be avoided. We say to our hospital dietitians: "We want a low carbohydrate diet." It isn't enough; it will not help unless we go into the differentiation of carbohydrates.

I was very glad that Dr. Ewerhardt brought up that question of massage. We must not stop using judgement in the kind of massage we apply to our cases. I think it is just as important to decide about the kind of massage you are going to use as it is about the kind of medicine or the kind of other treatment that you are going to use, and it will come down to the fact or to the principle that undirected physical therapy is almost hopeless. The hospital's physical therapy department without a trained medical head is not going to succeed to any great degree.

I merely want to say in closing that I believe chronic arthritis is at present the greatest detriment to human health and happiness, and I think I can further say that the problem of chronic arthritis is the greatest or the most unsolved problem that we have in medicine today.

ULTRAVIOLET THERAPY IN PEDIATRICS*

RALPH H. KUHNS, M. D.

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In the past eight to ten years a new therapy has been added to our armamentarium. It is an outgrowth of the work of Finsen of Copenhagen who employed light in the treatment of tuberculosis. His success led others to invent apparatus as substitutes for natural sunlight. In 1892, Arons discovered that an electric current passed through a vacuum tube containing a small amount of metallic mercury produced a peculiar bluish light containing no red or orange rays. Not long after, Cooper Hewitt, an American engineer, patented a lamp based on Arons' discovery. The next step toward a mer-

cury lamp of therapeutic value was the successful fusing of quartz crystal by Heraeus, and the manufacture of vacuum tubes of this material. From then on improvements followed until we have the efficient quartz lamp of today.

There is hardly a branch of medicine in which the quartz lamp is not employed. Whether it is to serve as a panacea for some of the ills of mankind, time alone will prove. Suffice to say, that in the deficiency diseases and malnutritions of childhood it has shown a real value.

Rickets. In 1917, Alfred F. Hess and Lester J. Unger, of New York, made the first attempt so far as is known to cure rickets by

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ultraviolet rays. They used a mercury vapor lamp which produced short rays of less than 300 microns in length. Their results were not definite. In 1921 a second attempt was made using the x-ray as a control. Six infants who had a mild degree of rickets and were on various diets were selected for treatment. They had developed rickets on diets of "pasture dry milk," malt soup, condensed milk, breast milk, etc. The treatment was given three times a week for a period of two months. The entire body was exposed to the rays, at first for a period of about three minutes, increasing gradually to twenty minutes. The hemoglobin percentage and number of red cells increased in every instance. X-ray examination showed a definite improvement in the rickets. The earliest beneficial effect was noted in two cases in twenty-six days after seven treatments had been given. There was no change in the diet during this period and the improvement occurred in all infants during the months of February and March. Their results helped to explain why rickets preponderates in the large cities where the infants are closely housed during the winter.

Gerstenberger believes that such factors as heredity, lack of exercise, cows' and human milk containing diets and vitamines, all play merely secondary etiologic roles to the primary and fundamental cause of rickets, which is inadequate exposure to the actinic rays or their equivalent, in growing human infants. Therefore in order to prevent rickets, he advocates administration of cod liver oil or exposure of the child to the actinic rays not later than the beginning of the second week of life.

Kramer, Casparis and Howland treated five rachitic children, four colored and one white, by systematic exposure to the rays from the mercury vapor quartz lamp and in every instance roentgenographic examination showed a healing of the rachitic process in the bones. The inorganic concentration of the serum of these children was low (from 2.7 to 3.2 mg.) before the treatment was begun and gradually increased to a maximum of 6 mg. with the appearance of calcium deposition in the bones.

F. F. Tisdall regards ultraviolet therapy by means of the ordinary air-cooled mercury vapor

quartz lamp as an absolute specific in the treatment of rickets and tetany. In a recent paper, in collaboration with A. Brown, Tisdall states that from October to March the antirachitic effect of the sun is so slight that the benefit to be derived is purely problematic, and has yet to be determined for the human being. The use of the special glasses is of value from March to June when the chemically active rays are very beneficial and the weather is too inclement for outside exposure.

S. A. Levinsohn reports an advanced case of rickets in a negro child which was cured with ultraviolet rays in six weeks. In his opinion, pigmented skin does not appear to have a retarding effect on the curative action of ultraviolet rays in rickets, since they do not have to penetrate the pigment in order to activate the cholesterol in the epidermal cells. This antirachitic cholesterol can be absorbed by the capillaries of the skin to exert its systemic effect.

Malnutrition. In cases of malnutrition of infants not of rachitic origin, ultraviolet radiations have had a tonic effect. The reason for this is not clear at present. Russell believes it is due to a number of effects on the living organism. It increases metabolism by increasing oxidation in the cells and is thought to act as a catalyst. It is thought also to affect the fat metabolism by acting on the cholesterol content of cells. It affects sleep in some way. Russell noticed that his cases slept better during and after a course of treatment. He reports six cases all non-rachitic which showed marked improvement after three weeks' treatment with the quartz lamp.

Effect on the Blood. Sanford studied the effect of ultraviolet light on the blood of newborn infants. His study was based on a series of fifty newborn infants, all of whom were normally delivered. The mothers were not subjected to anesthesia so there was nothing to interfere with the bleeding and coagulation time. The bleeding time, coagulation time, and blood platelet count were taken immediately after birth and at intervals of twenty-four hours thereafter. At the end of the fourth day the ultraviolet treatments were begun on alternate infants. His conclusions were that short exposure

to the ultraviolet light lowers the bleeding time of the blood in the newborn infant but does not affect the coagulation time. The platelets are increased but not permanently so. Short exposures to the ultraviolet light would serve as a therapeutic measure in infants with delayed bleeding time, but their coagulation time would have to be decreased by other measures.

Whooping Cough. Bru Camille employed ultraviolet light during an epidemic of whooping cough. He found among all ages and conditions of children that 80 per cent were cured and 10 per cent improved, while the remaining 10 per cent were not affected by the treatment. Erythema occurred nearly always after the third treatment and was accompanied by a decrease in the number and violence of the coughing paroxysms, lessening of the fatigue, diminution of vomiting and improvement of the general condition.

At the Children's Memorial Hospital we have been using the quartz lamp for some time and the results have been quite satisfactory. In addition to using it in rickets and other deficiency diseases of infancy and childhood, it is employed in tuberculous sinuses and glands. Great precautions are taken in the use of the light. No child is treated if the temperature is 100.6 or over, or if the skin shows a rash or desquamation. The eyes are bandaged during the treatment. Children with tuberculosis are always treated one at a time and after the irradiations to the other children are finished.

From our work at the Children's Memorial and a review of the literature, it is evident that ultraviolet therapy has an established place in pediatrics.

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DISCUSSION

DR. EDWIN L. LIBBERT (Lawrenceburg, Ind.) This is an interesting review of literature on ultraviolet therapy in pediatrics. There are just one or two points I should like to ask Dr. Kuhns. In the first place, the plan of treatment which is followed by your hospital, I mean so far as duration of treatment and the frequency with which the treatments are repeated in an effort to get at the ergosterol approximate dosage schedule. The work of all these investigators has been directed toward finding the substance upon which the actinic rays act to produce the result, and they found, as the doctor has said, that cholesterol was that substance. It was later shown that the ergosterol and impurities of cholesterol was the substance so activated.

A certain firm has been marketing this in a preparation supposed to be very much more concentrated, and necessarily is, than ordinary cod liver oil; so much so that they claim a drop is equal to a teaspoonful and a half of good standard cod liver oil.

Now, then, another point which has come out is the fact that the feeding of this preparation is not of itself sufficient to be of marked antirachitic value because they claim that it cannot produce the antirachitic effect unless the growth-producing vitamine is also present in sufficient quantities, which is the plain vitamine A. As the result of that, I have tried in a very few cases, three to be exact, the use of the ergosterol alone and then a combination of ergosterol with cod liver oil preparation which is excessively rich in vitamine A, and have noticed very satisfactory results in those three cases. Of course, that is not a sufficient number to draw any conclusions from, but it is just the observation in those few cases.

I think that is one thing that should be borne in mind by all of us, that ultraviolet of itself is not a specific for rickets in particular unless the other vitamine factors are upheld in an equal manner.

So far as its use in whooping cough is concerned, I have not had experience with that, and the literature, I think is about equal, about half get good results and the other half get little or no results.

For glandular involvement and for some obscure conditions in which we cannot make an accurate diagnosis, in which we are reasonably sure that there is

some lymph gland factor concerned, ultraviolet is of tremendous benefit, particularly the type which has just recently come to our notice: The mediastinal lymph gland. I think that a good many of the low-grade fevers occurring in children are due to an involvement of the mediastinal lymph glands which can be treated successfully by the use of ultraviolet in proper dosage. My idea of the dosage for that is an exposure of two or three minutes depending upon the nature of the individual and then to be increased from a half to a minute at each succeeding dose. The treatments are to be given on alternate days, because I don't believe it is effective, except in very few cases, to administer ultraviolet radiations every day. A cumulative action takes place which produces untoward, depressing effects on metabolism. We should therefore guard against overdosage.

DR. NAIR: I should like to ask Dr. Kuhns if he has paid any attention to urinary findings in the cases under ultraviolet rays. I had in mind one physician who said it has a marked beneficial effect in reducing sugar and I wondered if Dr. Kuhns paid any attention to the urinary findings.

DR. BRAIS (U. S. Veteran's Bureau): I should like to ask this question: Has the doctor had any experience in treating different types of complexions of the skin? In our experience in practice we have found that there are, for instance, for blondes and brunettes, the black and red, and the blondes are the most receptive to ultraviolet ray progressively until we reach the reds where there appears to be no reception of the ultraviolet ray. I am unable to get any reaction to it, any reddening of the surface of the skin.

I should like to know what has been the experience of others on these different skins and what may be the explanation of it.

DR. J. C. ELSOM (Madison, Wisconsin): While we are waiting for further discussion, let me, if you please, cite the instance of a colored child that we had in our hospital with a marked case of rickets. The pediatrician in charge was faced with the problem of whether the ultraviolet would affect the black skin. I told him that if he didn't want to try ultraviolet we would irradiate the milk that the child took regularly and see what effect it produced. The hospital would daily send up the milk the child was to take, and we placed it in a very shallow sterile vessel, and rayed it

for twenty-five minutes, at a distance of twenty inches. The improvement in the child was very marked, indeed, and we checked up this improvement with the x-ray every week. At the end of the first week there was visible improvement; the second week it was quite marked; the third week the fissures of the bones were beginning to unite, and by the fourth week the child was walking. This little fellow was two years old and had never walked before.

This pediatrician in charge was quite impressed with the value of activating foodstuffs. As a matter of fact, it has been my experience that colored skins absorb the ultraviolet really better than the white skin, shutting out necessarily the short rays, I think, the short irritating rays, and that is the reason that the white skin pigments, because the skin attempts to shut out these short, irritating rays. But the longer rays, those which produce the systemic effect, are readily absorbed into the black skin as they are in the white skin, better perhaps than they can be absorbed into the tan skins.

I think that is a fact we should bear in mind.

DR. RALPH KUHNS (Closing): In regard to Dr. Libbert's question about technic, I think we have given it as well as we could at the Children's Memorial Hospital here. We start with two minutes' exposure and continue this treatment every other day, increasing the exposure until we have the children under the lamp for a period of fifteen to twenty minutes. We never keep children under it longer than twenty minutes.

In regard to Dr. Nair's about sugar, urinary findings, I can't answer the question about urinary findings changing by the ultraviolet treatments. I have never had any such experience.

As to the question from the doctor from the Veteran's Bureau, about the different people and their reactions to the rays of light, whether they are blonde or brunette, or red-haired, of course, they will react differently, the same as the sun's rays effect people differently.

Dr. Elsom brought out in his remarks that colored people do absorb the rays. I brought out in my paper that if the ultraviolet rays are absorbed it isn't necessary to penetrate the skin. All that is necessary is for the rays to be absorbed by the initial layer of the skin and thereby cause their beneficial results.

A METHOD OF CONTROLLING THE DESTRUCTIVE ACTION OF THE ROENTGEN RAY ON LIVING TISSUE*

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The roentgen ray is a lethal ray and its application in therapy is made possible only by keeping the dosage below the danger point. The dosage range, in which the ray is thus practically effective and not dangerous, is small, and the radiotherapist, conservatively, is apt to err today on the side of underdosage at the sacrifice of the therapeutic effect. Were it possible to control the effect of the ray and to counteract the disastrous sequelae of even an accidental overdosage, this valuable therapeutic agent might be used to greater intensity and with greater courage.

One cannot state at present just what the roentgen ray does to living tissue or how it does it; we only know tissue death can follow certain exposures to the ray. That this effect varies in different tissues is surely not due to differences in the ray, which in nature does not vary, but to intrinsic differences native to the tissue affected. Physicists—Stokes, Thomson, Barkla and Bragg—regard the roentgen ray as consisting simply of electrons in an oscillating or pulsating system capable of varying penetrations. The depth and extent of the penetration is dependent on the potential behind the ray. "Hard" rays differ from "soft" rays merely in the greater voltage behind the former. The "harder" the ray, the further it goes in the tissue.

The roentgen ray excites no effect so long as it is in motion. Only at the point where its progress is arrested are electrical and physical effects brought about. At this point of arrest, the ray liberates negative electrons (cathode particles) which tend to suspend the activity of the positively charged particles which lie in the immediate vicinity. The importance of this activity of the positively charged particles for the life and functions of the body cells will be referred to at greater length in this article. I

believe that both the therapeutic and destructive action of the roentgen ray on living tissue is due to its capacity to liberate cathode particles where its progress is stopped. Reasoning from this, it seems obvious that, if we hope to prevent or minimize the destructive effects of the roentgen ray in living tissue, we must develop some means of restricting the activity of these released negative electrons, or of overcoming or neutralizing the negative charge they carry. It is with this idea in view that the present research was begun.

Some years ago I was so unfortunate as to inflict a severe roentgen ray burn on a patient I was treating. Believing that the above theory is valid and that the neutralizing result could be obtained from Guillemont's oscillating circuit, I connected the patient into the oscillating circuit of a Guillemont spirals so that the current was conducted out through the lesion. This burn healed in an entirely satisfactory manner. After the above mentioned experience, I began to experiment with animals in an attempt to neutralize the lethal effect of roentgen ray overdosage. Rabbits were chosen because of the ease with which they can be obtained, handled and kept for observation. For the neutralization, different types of standard medical oscillating circuits were tried with such indifferent results that it was soon realized that the ordinary medical apparatus was inadequate to supply the necessary volume of current. None had a current power that was comparable to the power of the modern roentgen ray apparatus. I turned from the medical to the practical electrical engineer and through the co-operation of Mr. Harry Wirtz of the New York Edison Co., whose scientific interest has made this work possible, the inductance values and the transformer capacities for the circuit described here were evolved. The results reported below speak for the efficiency of the apparatus.

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ANIMAL EXPERIMENT NO. 1

The animal experiments were begun in October, 1925. Two rabbits as near the same weight and blood lines as possible were exposed to x-ray on October 17th and October 21, 1925. The dose was: Gap, 7 inches, 2 Ma., 10 inch distance—time sixteen minutes and forty seconds, no filter. The position of the animals was changed during the exposure to obtain as nearly as possible an even distribution of the x-ray over their backs and heads. One animal was neutralized in the oscillating circuit four times between the 17th and the 26th, for a total of one hundred ten minutes. Nothing further was done with the control (unneutralized) animal. Leukocyte count, October 22nd, 1925, of neutralized animal was 2100, unneutralized animal was 2400. Occasional leukocyte counts were made up to November 2nd, 1925, at which time the neutralized animal's count was 5400, the unneutralized animal's 3400. On December 16th, 1925, the neutralized animal showed 8700 leukocytes and the unneutralized animal, 11900. On December 22nd, 1925, the unneutralized animal was found dead. Postmortem showed a much distended gastro-intestinal canal. The neutralized animal continued in excellent condition and on October 15th, 1926, it was given away for a pet (Fig. 1). This animal died April 17th, 1927, eighteen months after the first experiment, and no postmortem was performed.

ANIMAL EXPERIMENT NO. 2

On January 14th, 1926, two rabbits, females, of the same litter and weight, were obtained for experimental work. The animals were kept under observation with weekly complete blood examination and daily weighing. On February 16, 1926, x-ray dosage and neutralization was done under the same conditions as in the first pair. On February 16th, the neutralized animal's leukocyte count was 2150, the control 2500. Between February 18th and 20th, the unneutralized animal's weight dropped from 6 pounds, $1\frac{3}{4}$ ounces, to 5 pounds, $5\frac{1}{4}$ ounces. It remained in its sleeping-box almost continuously and merely nibbled at food. From February 20th to March 3rd, the unneutralized animal increased in weight to 6 pounds, $6\frac{1}{2}$

ounces, despite a noticeable loss of appetite, while the neutralized animal increased to 6 pounds, $6\frac{3}{4}$ ounces. Both animals were killed and subjected to autopsy. On opening them, the difference in the gastro-intestinal canals was striking. The weight increase of the unneutralized animal was found to be due to the retention of an enormous, foul, sour-smelling food residue in the stomach and in the small and large intestines, whose mucous membrane was reddened and blood vessels dilated. The neutralized animal showed none of these changes. The amount of food residue in the stomach and the small and large intestines was what one ordinarily finds in a healthy rabbit. Since the rabbit is not equipped with a vomiting mechanism, the food accumulated in the gastro-intestinal canal of the unneutralized animal and produced an increase in weight, a fact which can readily be understood. The irregular up and down curve of the leukocytes in the unneutralized animal was due to the toxic absorption from the intestinal canal and not directly to x-ray action. This irregularity in the leukocyte curve has been noted by other observers who have radiated rabbits. (Aubertine and Beaujard.)

ANIMAL EXPERIMENT NO. 3

On April 26, 1926, two rabbits, one weighing 6 pounds, $\frac{3}{4}$ ounces, all brown, and one weighing 5 pounds, 6 ounces, with a white blaze on his face and an enlargement of the joint of the left hind leg, were selected for experiment.

X-ray dosage began April 27th, 1926, consisting of 3 Ma., 10 inch distance, 4 inch gap; time fifteen minutes. Following each dosage the white-faced rabbit was neutralized. Few blood counts were made after x-ray dosage was begun. The physical condition of the animals was judged by their weight curves and manner of eating. Following this, doses were given at intervals up to May 12th, a total of 420 Ma. From May 12th to July 19th there was no additional x-ray application, but the white rabbit was neutralized at intervals during this period. From July 12th to July 19th daily intense neutralization doses were administered to the white-faced rabbit. Beginning July 19th, the animals were subjected to further roentgen ray applica-

tions and the penetration was raised to 7 inches for 210. Ma. From July 19th to August 14th, they received radiation to the total of 630 Ma., making a grand total of 1050 Ma. since April 26th. The white-faced rabbit received neutralization at intervals from July 19th to August 14th. From August 14th there was no further x-ray or neutralization. The reason for the length of time of the experiment—one hundred twenty-eight days—was to permit the observation and study of the effects of the various penetrations, and to determine the best methods and best time for application of the neutralization energy. X-ray dosage was stopped on August 14th, as the unneutralized animal seemed certain to die in a few days. On August 14th, the weights were: neutralized animal, 5 pounds, $\frac{1}{2}$ ounce, the unneutralized ani-

restless when any attempt was made to touch his back. I was unable then to understand this animal's behaviour, but when this wet spot appeared on its back, I considered it to be due to destructive skin changes from the effect of either the neutralization energy on the radiated area or insufficient neutralization. Probably it was the latter.

Beginning on the sixty-sixth day, heavy neutralization doses were administered for six periods ending on the seventy-second day. Two days later, the wet area showed some loss of fur and a raised dry scab containing fur, indicating a complete arrest of the process (Fig. 4). None of the fur about the margin could be pulled out, and there was a complete disappearance of the tenderness. Following each of



Fig. 1. Neutralized animal on July 8, 1926, eight months after x-ray dosage lethal to his mate in seventy-two days.

Fig. 2. Unneutralized animal, June 26, 1926, the sixty-first day. Initial changes noted June 6, 1926.

mal, 6 pounds, 2 ounces. On August 17th, the animals weighed: neutralized animal, 5 pounds, $\frac{2}{3}$ ounce, unneutralized animal, 6 pounds, 8 ounces.

There was a striking difference in the time of the appearance of the skin lesions. The unneutralized animal showed the first change on the thirty-third day. The ears became parchment-like and the back showed loss of fur. (Fig. 2.) The neutralized animal did not show any changes until the fifty-fourth day, when a wet spot in the fur over the right kidney region was observed (Fig. 3).

Previous to the appearance of this spot the neutralized animal was noticed to act wildly

Arrows indicate epilation of fur from ears and back.

Fig. 3. Neutralized animal, June 26, 1926, the sixty-first day. Arrows indicate lesion probably the result of insufficient neutralization.

these heavy neutralization doses, the animal exhibited prostration and thirst, and would sleep for from two to three hours. There was loss of weight, the animal dropping from 6 pounds, $\frac{3}{4}$ ounce to 5 pounds, 3 ounces.

The penetration of the x-ray up to this time had been four inches, parallel spark gap. The later x-ray dosage was administered with the penetration raised to seven inches parallel spark gap.

For the balance of the experiment, the neutralization methods were changed, as explained later, as there was no doubt in my mind that a method of control of immediate x-ray effects was at hand. The changed neutraliza-

tion technic was partially successful. It prevented loss of body weight, disturbances of digestion, and death, but it did not prevent superficial effects, although it delayed their appearance and so modified them that healing took place promptly.

On August 19th, the unneutralized animal was found dead. The autopsy showed: weight, 5 pounds, 5 ounces, ears parchment-like, with thickening and obliteration of the blood vessels. There was no fur on the back from the base of the skull to the slope of the rump (Fig. 5.) A large dry depressed scar was present over the lumbar region. The stomach was moderately distended. The small intestine was empty in places; other portions contained fecal material

electrochemistry, and can be observed and studied only in living cells while they are exposed to the electrical energies. This will require the use of the "ultra-microscope."

HUMAN EXPERIMENTS

Analysis of these animal experiments seems to demonstrate that deep tissue dosage can be controlled, over-dosage neutralized, and x-ray sickness prevented. Surface damage can be prevented or profoundly modified, but this needs many times the amount of neutralization energy that is required in deep damage, since the action is greater in the more superficial tissues. Neutralization of animals is a difficult problem since the fur prevents the intimate skin contact so

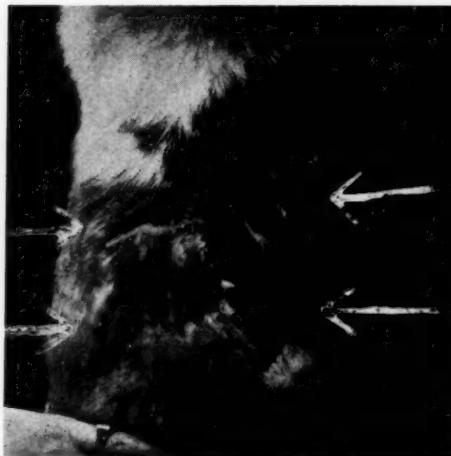


Fig. 4. Twelve days interval between Fig. 3 and Fig. 4. Arrows indicate elevated scab containing fur. Process arrested.



Fig. 5. Compare with Fig. 2. Note rapid increase in lesion in twelve days. Arrows indicate epilated area and thin dry depressed scab.

and blood-stained mucous. The neutralized animal continued to eat well and the body weight remained stationary, until October 1st, the one hundred fifty-eighth day of the experiment. From the one hundred twenty-third day—the day the unneutralized animal died—there was no further neutralization. On the one hundred fifty-eighth day, October 1st, the neutralized animal was chloroformed and autopsied. The gastro-intestinal canal showed no abnormalities.

No microscopic tissue work has been done as the very nature of the x-ray is such that observations of the effects of radiant energy on tissue must be made on the living cell. The problem is one of electrobiology rather than of

necessary for the proper distribution of the neutralization energy through the radiated area. It must be remembered that these animals were radiated *in toto*, which a human would never be. The skin of fur-bearing animals is far more resistant to the x-ray than the human skin. The skin of a pig closely resembles the human skin in this respect.

Limited laboratory facilities prevented the use of pigs, so I decided on the use of the human skin as the only alternative. Several of my friends and assistants volunteered for the experiment. I was reluctant to subject others to such an experiment and decided to use my own skin, selecting the hairy portion of my left arm;

feeling certain, after my results in treating x-ray damage of humans, if any harm did result, it would not amount to more than the loss of the hair and a few sweat glands.

For the purpose of the experiment on my arm, I selected a dose that would be certain to produce a profound skin disturbance. I could hardly be considered a favorable subject for such a test as, up to the beginning of this experimental work in October, 1925, I was hypersensitive to the x-ray, especially my face and hands. This sensitiveness became noticeably

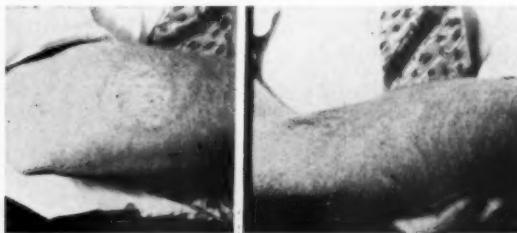


Fig. 6. Human skin twelve months after radiation Sept., 1927. On right arm note area radiated and incompletely neutralized, devoid of hair. The same area on the left arm received the same x-ray dosage and was carefully neutralized. No visible changes.

less in the spring of 1926. The skin over the knuckles of the right hand gradually softened and returned to normal. The splitting and brittleness of the nails lessened. This improvement took place in spite of my continued exposure to the x-ray in my practice and I believed this was due to the effect on my body of exposure to the neutralization energy during the animal experiments and treatment of patients.

On July 23rd, 1926, a two-inch circular area of my left forearm was exposed to the following radiation quality: 7 inch sphere gap ($\frac{7}{4}$ inch point gap) 3 Ma., no filter; time, 12 minutes. Measured by the ionization chamber this radiation quality equals 1150 roentgen units, $2\frac{1}{2}$ times an erythema dose, or 3.2 McKee skin units. For this specific radiation quality, 450 roentgen units is an erythema dose in four minutes and forty-five seconds. Neutralization began about one hour after radiation of the arm. A few hours after the initial neutralization, the radiated area became pinkish red, and in a few days felt raised to the touch, and there was a

definite increase in surface heat. This area was neutralized at intervals during the following weeks until sixty days had elapsed. The hairs were tested by traction from time to time. On August 23rd, 1926, twenty-one days after radiation, a fine desquamation was observed. On August 24th, one hair pulled out; on August 26th, three hairs pulled out. It was found that the same degree of traction applied to hairs in the unradiated portion of the arm would extract hair. Thirty-five days after radiation the hair was noticeably thinned. At no time during the months of observation was this spot hairless. Sixty days after radiation there was a noticeable growth of new hair (August 1st, 1926).

September 1st, 1927, fourteen months after radiation, the area when viewed by artificial light could hardly be made out. Viewed in good daylight the area is a lighter shade than the rest of the arm. The hairs seem to be about as numerous as on the rest of the arm. There are no changes such as pigmentation or scar tissue.

Unradiated areas of the skin were subjected to intense neutralization with no increase of the surface heat, redness or falling of the hair.

As a control of this experiment and animal experiment No. 3 where the wet spot appeared on the fur of the partially neutralized rabbit, I decided to repeat the dose on my right arm with but a slight degree of neutralization. On August 30th, 1926, the right arm was radiated, using the same sized area and location as on the left arm. Thirty-six hours later the first neutralization was applied and thereafter every forty-eight hours for six short doses. The redness noticed in the first experiment did not fully appear until the fifth day. Surface heat was less than on the left arm. On the fifth day the elevation above the surrounding skin seemed to be about the same as it was on the left arm. During the first twenty-one days, no additional changes were noted; then blebs formed with a serous exudate, the lesion resembling a severe sunburn more than anything else. The lesion was painless even when firmly grasped and squeezed. At twenty-eight days all the hair had fallen out. On October 11th, forty-one days after the radiation, the area completely healed,

with total loss of hair, and some streaks of soft scar tissue. The openings of a few sweat glands can be seen. This area is slightly depressed below the surface of the surrounding skin. September 1st, 1927, twelve months later, the lesion is unchanged (Fig. 6).

THE NEUTRALIZING APPARATUS

The discoverer of the high oscillating current was Thomas Edison. He described his discovery in the *Scientific American* of December 25th, 1875, where he proposed the name of "Etheric Force" for the phenomenon. Edison observed all the characteristics of the high oscillating current, the lack of polarity, and the fact that a metallic circuit and insulation were not necessary. It would not charge a Leyden jar nor did the force affect compounds sensitive to electricity. It had no effect on electroscopes or galvanometers. It is not felt by the tongue and causes no contraction of the properly prepared frogs' legs, unless an exceedingly strong battery was used. The circuit described here is essentially the early wireless sending set with a large capacity transformer and a large condenser in place of the induction coil and small condenser. The addition of these units give the circuit the capacity to cause tissue effects of great magnitude just as Edison observed that the addition of a large battery to his circuit caused tissue effects, such as muscle contraction, in the properly prepared frogs' legs.

The apparatus as used by the author is constructed as follows (see Fig. 7):

A-B. One K.W. Standard commercial type transformer. The reactance should not exceed 10%. Low voltage, 220; high voltage, ten, fifteen and twenty kilo volts.

C. Spark-gap—a Poulsen arc.

D. Variable glass condensers. Plates 10 x 12 inches. Element, sheet lead .005 thickness, 5 x 7 inches. Thirty-six or more plates are used, divided into three or more groups or banks.

G. Ground connection to water or steam pipes.

E. Tapped primary consisting of nine turns of No. 6 insulated copper wire. One side

of the transformer and spark gap is tapped into the third turn of the primary. First turn of the primary is tapped into the first turn of the resonators. Selector switch is used over a range of six turns, from the fourth to the ninth turn. The primary E may be inductively instead of directly coupled as shown in the diagram. The direct coupling seems to give a greater range of control. Voltage resonance is found at the sixth primary turn and diminishes as the primary turns are added. Added turns increase the power or capacity resonance or condenser action.

F. The resonator or secondary consists of two inductances, one long and narrow and one short, of greater diameter. A cylinder ten inches in diameter, wound for a distance of twenty-two inches with annunciator or bell wire makes the long end. The short end consists of a cylinder, 16 inches in diameter, built of sheet fibre on wooden discs. This is wound with annunciator or bell wire for a distance of seven inches. The primary surrounds the long end and is separated by an air gap of at least three but not more than four inches. The first primary turn is about two and a half inches distant from the short resonator; the exact point for best voltage resonance being found by trial. By the first turn of the resonator is meant the turn nearest the first primary turn. All windings, primary and secondary, should be in the same direction, preferably clockwise.

Construction of the short resonator is optional as these experiments were carried on without it.

The transformer was supplied by the Packard Electric Co., of Warren, Ohio, and is their "Type A," capacity 1000 watts. It is distinctive in having a variable primary giving a high voltage range of ten, fifteen and twenty thousand volts. A voltage from five to ten thousand volts is the best operating potential for this circuit. As all electrical supply lines are heavily grounded, the grounding of the circuit at point G makes necessary the use of the one to one transformer —H. The use of this transformer is especially important where a rotary convertor is used, as the back lash from the condensers is certain otherwise to burn out the convertor in a short time. The one to one transformer does not

change the voltage but acts as a magnetic coupling, preventing the blowing out of fuses or burning out the convertor. The capacity of the one to one transformer should be two kilowatts or more. The spark gap (G) is a copper, carbon arc. The contacts should be at least one inch in diameter and the copper contact water-cooled, for if the copper becomes overheated the gap will not oscillate. Poulsen originally designed this gap to work with direct current and to operate in a hydro-carbon vapor, but it will operate in this circuit as indicated, so long as it does not become over-heated. The polarity or current connection is determined by trial.

The condensers D should be divided into three banks, or, if there is space enough, smaller

The operator must observe every precaution especially making no adjustments of the selector switch while the machine is in operation. The operating table should be as free from metal as possible and fastened together with wooden dowels, not metal nails or screws. The floor should be of wood, laid on wooden beams. Steel buildings that have reinforced concrete floors require a wooden platform for the operator, at least one inch thick, doweled, unpainted and unvarnished.

The circuit is grounded at G to permit a feed back into the resonator. This feed back is not metallic but is a leakage return operating as a closed circuit. The grounding of one side of the condensors and resonators through the

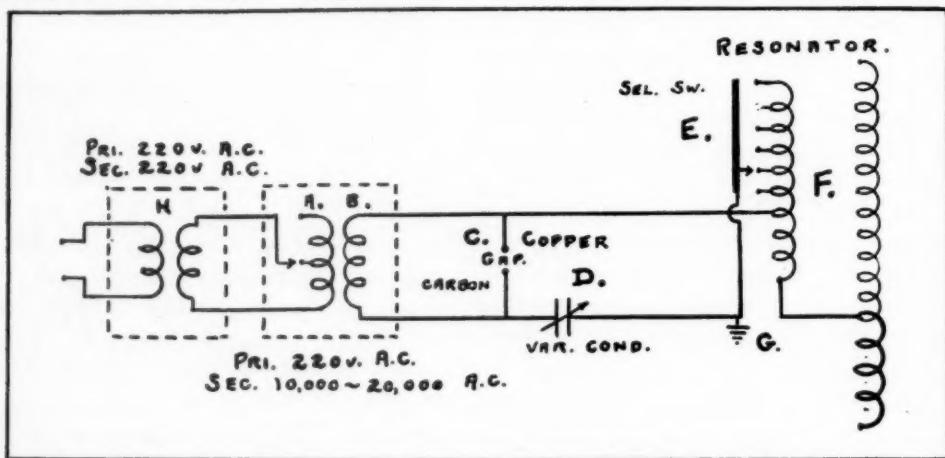


Fig. 7. Diagram of the neutralizing circuit. (See text for explanation).

banks which affords still better cooling. If the plates are shellaced they must be thoroughly baked afterward, otherwise the shellac melts and fuses the plates together, causing the glass to break as there is thus no allowance for the strain of charge and discharge or heat expansion. Condensor supporting shelves should be of glass.

It is recommended that all bare wooden surfaces in this apparatus be covered with an insulating paint. Further details of the circuit and of others of similar construction will be found in the "Handbook for Electrical Engineers." Fourth edition, section 21, paragraph 264.

METHODS OF APPLICATION

Workers with this apparatus must ever keep in mind that this is a circuit of great power.

primary is the reason for the special precautions mentioned above. Neither the operator nor the patient should ever come in direct contact with the wires or pipes connected to the ground wire at G.

Neutralization of the human is done in the following manner. The patient is lying on the table on his back and a large piece of tinfoil at least one foot square is applied to the back. The foil is then connected to the resonator at F to raise the patient's body potential to that of the resonator. A vacuum electrode with an insulated glass handle and exhausted almost to a green fluorescence is held by the operator and applied to the area to be treated. The operator touches the lead out wire of the electrode with a metal staff in his free hand, thus grounding

the current through his own body, from which the current leaks back into the condensors and the resonator through the ground G. During the passage of the current the electrode must, at all times, be kept in intimate contact with the patient's skin.

Neutralization of the animal's required a radical change in procedure. It was obvious that the vacuum electrode could not be used as the necessary intimate skin contact is not possible, due to the fur.

Two methods of application were worked out and the first described is preferred. The fur is removed from one leg, the skin moistened and wrapped with foil. The animal is then placed in a small box and the leg electrode connected to the ground wire G. Above the animal and beyond sparking distance is suspended a metallic distributor connected to the resonator F. The distributor was made from a steel wire brush. The position of the animal was shifted from time to time during the treatment so as to obtain an even distribution of the neutralization energy.

The second method was to cement foil into the bottom of the box, making a shallow cup which was filled with water. The animal was placed in the cup and the cup was connected with the ground G.

It was noticed that neutralization by the first method made the animals thirsty and sleepy. Appetite was not affected, weight remained stationary or diminished under heavy dosage. The second method lessened the above effects but is not so efficient in its neutralization effect.

In connection with the loss of weight, thirst, fatigue exhibited by the neutralized animal, I have noticed after working with this circuit, using it not only as a neutralizing agent but as a therapeutic agent otherwise, that I experienced thirst and fatigue. I have lost weight. Working constantly with the apparatus one ceases to notice the fatigue or thirst. The loss of weight in my case has been very gradual and at the expense of adipose tissue; of which tissue I had and still have plenty to lose.

DISCUSSION

An experimental work of this kind could not be undertaken without going into the theories of the action of the x-ray and of high oscillating currents on radiated and unradiated tissues. The x-ray beam can be regarded as a colloid system made up of the oscillating electrons and acting on the various colloid systems of the body as a negative electrolyte, the negative electrons in the x-ray beam adding energy to some systems and liberating energy from others.

The x-ray beam must be considered as one method of electron liberation, the negative electron being always the same as regards the ratio of the charge to the mass. This ratio does not depend on the voltage, the kind of gas in the tube, or the electrode material nor is the ratio of charge to mass changed if the electrons be liberated by heating of metals, intense bombardments, ultraviolet light or other means. The electrons vary only in the degree of dispersion at the point of arrest and the area of dispersion varies directly as the applied energy or voltage. The higher the voltage the greater the area of electron dispersion. Their properties as regards mass and charge are the same, however they may be liberated. The ratio of charge to mass is a definite constant about 1846 times smaller than the ratio of the charge of the hydrogen ion liberated by electrolysis (Compton). However, the electrons are liberated, they must be considered as one of the units of which matter is composed and the x-ray beam must be regarded as one method of adding to or liberating one of the fundamental units composing the colloid systems of the body.

Differences observed between the action of hard and soft rays are due to differences in voltage. The soft ray has a more intense action as its area of electron distribution is less and, in the case of the skin or other surfaces, the action is further intensified by polarization. The radiation effect is more intense along the planes of the skin, the surfaces of the intestinal canal and ducts of the glands, at right angles to the direction of the x-ray beam than in planes parallel to it. Barkla found this increase in intensity to be about 15% and the characteristic secondary radiation to be quite unpolarized.

CONTROLLING DESTRUCTIVE ACTION OF ROENTGEN RAY—EVANS

The body is made up of three kinds of colloid systems, which differ in the electrical charges carried by their colloid particles. These electrical charges are positive, negative or neutral—the nature of the colloid not being considered. The body cells show colloid particles in active Brownian movement. This was demonstrated by Mott and Marinesco working on the cell bodies of spinal neurones. These workers found under dark field illumination, that the neurones were filled with colloid solution containing particles in active Brownian movement, nothing being seen of Nissel bodies or granules. Gaidukow and Hardy also found that the body cells contained colloid solution in active Brownian movement.

The effect of the x-ray beam is to cause changes in the degree of dispersion and size of the colloid particles. In positive systems the particles become larger and less active as the surface charge of the particles is lessened by the x-ray beam. In negative systems the particles become smaller and the Brownian movement more active as the size of the particles is decreased to provide for surface to accommodate the increased negative charge from the x-ray beam.

A continuation of these actions ends in true ionic solution or lysis. The defense of any colloid system against too great an increase or too great a diminution of its electrical charge is hydration. Neutral systems are totally unbalanced by the addition of the negative charge derived from the x-ray beam. As an example of a neutral system, the Succus Entericus has been found by Bechtold to contain neutral colloids. The presence of the negative charge derived from the x-ray beam in the Succus Entericus must induce an equally strong positive charge in the intestinal mucous membrane. This excess of positive charge causes the positively charged nuclear particles of the highly hydrated glands of the small intestine to become smaller with more active Brownian movement and hydration until true ionic solution or lysis is attained. Thus can be explained the extreme sensitiveness to the x-ray of the glands of the small intestine. The lessened sensitiveness of the same glands in the large intestine is due to

the protective action of surface colloids that here have an electrical charge either negative or positive.

The marked difference with which the gastric mucous membrane reacts is striking. The cells of the fundus are very sensitive to the x-ray while those of the pyloric portion are hardly affected at all, due to the positive charge of the secreted colloids of the latter and the neutral charge of those of the former. The pancreas is rather insensitive to the x-ray. The colloids in its secretions have been found by Iscovesco to be strongly electropositive. Iscovesco considers the biliary colloids to have an electronegative charge. The salivary glands and respiratory surface of the lungs are not sensitive to the charge of the x-ray. Under normal conditions the respiratory surface of the lungs has little secretion. I have no data on the electrical charge of the salivary colloids. It would seem in both cases that the charge must be electropositive. The blood vessel walls are extremely sensitive to the x-ray as are the leukocytes. The same electrical conditions are present in the blood vessels that are present in the small intestine. The blood can be classed as a colloid consisting of a fluid plus solids—the cells. The red cells contain a strongly electronegative colloid and hence are little affected by radiation, being permeable only by an anion.

The selective action of the x-ray is dependent on the difference of the electrical charge carried by the radiated colloid and not to a difference in the ray. The effect of the ray is to cause changes in the size and phase of dispersion of the colloid particles and degree of hydration of the colloid system. Hydration and change in the size of the particles is the colloid's defense against the increase or decrease of its electrical charge.

Among the methods used by The Svedborg to prepare colloidally dispersed metals was oscillating electrical charges. The availability of the high oscillating current led me to use the apparatus already described. The effect of the oscillating discharge is to set the colloid particles into increased motion through the shaking action of the large condensors, and to drain from the body the accumulated negative charge; in

other words, to stimulate the metabolism and dehydration of those colloid systems that have hydrated. That such dehydration takes place seems to be confirmed by the observation on the animals and by my personal experience.

The neutralized animals always exhibited extreme thirst following neutralization and if the neutralization was pushed, it caused loss of weight with no lessening of appetite. The unneutralized animal, after certain x-ray dosage was reached, ceased to eat but continued to drink and increase in weight. The weight increase is certainly not entirely due to the filled, distended gastro-intestinal canal. My personal experience has been that following exposure to the oscillating circuit, thirst and increased kidney function was noticed. My loss of weight has already been mentioned.

I wish to thank my associates at the Midtown Hospital, especially Dr. T. C. Schlauch and Dr. George H. Plehn for the many helpful suggestions and observations. In particular I wish to thank Miss Jean Scott, my assistant in the x-ray department, for her painstaking care of the experimental animals and her accurate laboratory work.

CONCLUSIONS

1. The sensitiveness of the colloid systems to the roentgen ray is in the following order: neutral, electropositive and electronegative.
2. The destructive effect of the roentgen ray is due to its tendency to cause colloid systems of the organism to hydrate until they undergo lysis.
3. The destructive effect of the roentgen ray on tissue can be prevented by a method that will maintain the normal colloid state of the tissue in the irradiated area.

4. The tendency of the roentgen ray to affect colloid systems may be neutralized by the utilization of a high oscillating electric circuit.

5. The circuit described has proven to have neutralizing value.

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DIAGNOSTIC ERRORS AS A CAUSE FOR MANY POOR END RESULTS WITH PHYSICAL THERAPY*

JULIUS BRAMS, M. D.

Physical therapy as an adjunct to our other therapeutic measures has assumed widespread acceptance. Every hospital of standing has a department set aside for physical therapy treatments, and in many instances a physician who has made a specialty of this subject is in charge of this department. The American Medical Association through its Council on Physical Therapy, has laid down certain standards for the development and improvement of this specialty. Societies, both local and national, have sprung up with memberships including some of our greatest scientists. Although still in its infancy the science of physical therapy has opened up an enormous new field for the use of new measures in the fight against disease. In the hands of the specialist many brilliant results are obtained in the treatment of diseases heretofore considered difficult or impossible to cure. Yet, in spite of this, those of us who use electrical apparatus are often confronted with criticism and abuse, and, not infrequently, we are told that we are practicing on the borderline of quackery.

Much of this is the result of our loose legislation which permits barbers, cultists, beauty specialists, etc., to own, operate, and treat diseases with electrical apparatus, sold by high powered salesmen to any ignoramus with the assurance that "there is money in it." It is not the purpose of this paper, however, to deal with this phase of the problem. We shall limit ourselves to a discussion of the widespread use of physical therapy in conditions where the benefits to be derived are questionable, or where there are definite contra-indications. Many untoward effects which have resulted in unfavorable criticism from the profession are due to the widespread, unscientific use, or shall we say abuse, of physical measures where no good result could possibly be hoped for. The only apparent indication for the use of electrotherapy was the fear of losing the patient, the desire to do some-

thing for him, or just gross ignorance. We do not wish to leave the impression that those who use physical therapy would deliberately abuse the privilege of treating the sick to the best of their ability. However, when one is engaged in a busy practice there may be a tendency to neglect the proper selection of cases for treatment. By this we mean that much of the criticism which befalls the general practitioner or specialist in this field might be avoided if more attention is paid to the accurate diagnosis of the patient before attempt is made to treat him. During the past few years we have had occasion to see a large number of patients treated. From time to time we have been amazed to find that treatment was ordered by an uninformed physician, or that a nurse or technician, not under the supervision of a physician, gave treatments which could not possibly have been of any value to the patient. For the purpose of this discussion, therefore, we have collected several examples of gross mismanagement, all of them practically due to an inaccurate diagnosis any one of these examples might be taken to indicate that physical therapy was not only contra indicated, but actually delayed recovery or was even harmful.

One of the commonest conditions we meet with in daily practice is "backache." This may be due to many different causes and can be treated in many different ways. Because of the almost uniform results in successfully treating this condition with physical therapy there has been a great tendency among physicians to begin treatment without much clinical investigation. As a result a large percentage of patients recover and a certain few do not. We have had occasion to examine the cases which did not respond to treatment and in a few cases have found kidney, ureteral, or bladder stones as the underlying cause of the pain. Nothing is more embarrassing to the physician and nothing can leave more room for criticism than to treat a patient for weeks without result to find that the backache was of stone origin. On the other

* Read at the seventh annual meeting, American College of Physical Therapy, Chicago, October 10, 1928.

hand nothing will repay the physician more and be of greater value to the patient than the routine x-ray examination of all cases of back pain. In addition to stones, there may be discovered arthritis, anomalies, fractures, etc., and a more sensible treatment can be instituted.

Another very common type of condition sent to the physical therapy department for treatment is the chronic draining sinus. We are all familiar with the almost specific results with the water cooled ultraviolet in promoting rapid, healthy granulation and closure of sinuses. We have had several cases which illustrate the necessity of a detailed and accurate investigation even of a draining sinus before commencing treatment. One of our patients was a chronic draining sinus of the abdomen at the site of a recent laparotomy operation. In spite of hot dressings, ultraviolet, mercurochrome, etc., the discharge continued for over a month. Finally the wound was opened with a hemostat and a good sized piece of silk-worm gut removed. This foreign body had prevented closure of the wound, and had it been discovered and removed earlier the patient would have been saved much time and expense. We have also had three cases of chronic nasal discharge for examination. These patients were first treated with ultraviolet for a number of days, but when the discharge became more profuse a more detailed examination was undertaken. One of the patients was an adult who had a nasal operation performed about a year previous. After physical therapy had failed to benefit this man the nose was carefully examined and a small, foreign body, granuloma was removed, which no doubt took origin from a piece of a retained cotton-plug, inserted into the nose at the time of the operation. The other two cases were in children. In one a pea, and in the other a collar button was found in the nares. The ease with which these cases could have been diagnosed, and the uselessness of physical therapy in the treatment of these cases needs no further mention. Another example representing pathology due to a foreign body is a woman treated for a chronic vaginal discharge. There was no apparent pathology other than that usually seen in such conditions. The discharge continued, however, in spite of all measures to stop it. An x-ray ex-

amination revealed a pessary within the cavity of the uterus, and, upon questioning, the patient admitted that she had had a pessary introduced but "had forgotten all about it." Still another example which came to our attention was a patient with an obvious maxillary sinusitis. The attending physician had irrigated the antrum repeatedly, and finally referred the case to the physical therapy department for treatment. After a number of these treatments the nasal discharge was as profuse as ever. The patient himself requested an x-ray examination and the physician agreed to this. He informed us, just previous to the examination, that the case was obviously a "good old fashioned sinusitis," and that he was ordering the x-ray merely to satisfy the patient. There was considerable surprise, however, when a tooth root fragment was found within the antrum. Closer questioning brought forth the history that a tooth had recently been extracted, and that the dentist at the time had remarked that he had broken the tooth while extracting it, but had removed it in its entirety. The antrum was opened surgically, the tooth fragment removed, and the patient made a prompt recovery.

Another great evil often seen in the physical therapy department is the treatment of a single symptom without any further effort at making a diagnosis. At times it is really astonishing to see what is attempted to be accomplished. For instance it has been our experience to see a patient treated for edema of the lower extremities with the electric current without any attempt made to determine whether the edema was of cardiac or renal origin without any effort to treat the essential pathology. Anyone who has seen a large number of cases has at least one history in his files which was treated for chronic constipation for months before a careful physical and laboratory examination revealed a carcinoma of the bowel. At the present time we are treating a boy for a wrist drop due to an injury to the radial nerve following an operation for osteomyelitis of the humerus. The boy has been treated over a year and there is no evidence of any nerve regeneration. The attending physician has repeatedly been informed that our treatments are useless and that we advise surgical repair as the only hope for a cure. We have

been completely ignored, however, and we are at present treating the patient entirely at the physician's responsibility. We feel that in this instance the neglect or ignorance involved is beyond our control. The history is cited because the patients will eventually travel around with nothing but the worst criticism against us; another physician will take up the case, the patient will condemn our department and will circulate the story of how we attempted to heal a severed radial nerve with electricity.

Time will not permit a more detailed discussion of our cases. Anyone can recall a certain number of patients that did not respond to treatment. If we seek the cause for failure in these patients we will probably find that the majority of them were not suitable for physical therapy treatment. By way of passing, however, we will simply mention a series of common diagnostic errors with subsequent mismanagement by attempting to treat these cases with physical therapy. It will be well to bear these in mind when cases are referred to us for treatment. Thus, it is always wise to investigate the case that is sent to us with a diagnosis of arthritis. We will repeatedly find malignant metastases, primary bone tumors, tuberculosis, etc., as the underlying pathology. In an old arthritis of the wrist a very common finding instead of the arthritis is a fractured navicular bone or a dislocated semilunar bone. Such conditions demand surgical attention and not physical therapy. It is also well to remember that all of the physical therapy in the world will bring no relief to the patient suffering from a temporomandibular pain, if this pain is due to an impacted molar tooth. In closing let us not forget a most dangerous blunder, that of treating for asthma when the actual pathology present is an aneurism of the aorta.

Any number of examples could be cited to illustrate further the points discussed above. Poor results invariably lead to criticism, and when it can be shown that the physical therapist erred, the criticism is doubled. This, while unfair, is not necessary and can be avoided by refusing to accept a patient for treatment from the attending physician without first demanding a diagnosis, and then only if the at-

tending physician is willing to accept the responsibility for the accuracy of his diagnosis. We do not hesitate to inform a patient or the doctor that ultraviolet is contra-indicated in certain types of tuberculosis. Similarly we should refuse a case for physical therapy treatment unless we feel reasonably certain that the condition will respond to this type of management. The diagnostic errors brought out in this paper are not intended to demonstrate the fact that we are not always perfect in our diagnosis or that patients are repeatedly mismanaged. We all are subject to a certain percentage of error and we all have our poor results. The internist, obstetrician, surgeon, etc., are guilty of as much error and mismanagement as the physical therapist, but the point we wish to emphasize is that by careful attention to accurate diagnosis and by proper selection of cases the physical therapist can minimize his errors and render a service which will be of maximum benefit to the patient. When the profession at large is given to understand that physical therapy is not a cure all, that an accurate diagnosis is absolutely necessary for the correct management of the case, that the physical therapy department of a hospital is not to be used as a dumping ground for all chronic and incurable conditions, that there are definite indications and contra-indications as well as limitations for physical therapy, and that physical therapy can only be prescribed by a physician who has made a special study of this subject, then, and only then, will this specialty be granted its place on a level with the other specialties in medicine.

CONCLUSIONS

The medical profession in general has assumed a rather doubtful attitude toward the efficacy of physical therapeutic measures in the treatment of disease. This is the result of many factors the most important of which are, first, loose legislation which permits any layman to own and operate electrotherapeutic apparatus, and second, the widespread unscientific use and abuse of this apparatus in the hands of the physician. With reference to this latter point a series of cases is cited to demonstrate that the treatment of certain conditions without an ac-

curate diagnosis first being made, the treatment of symptoms without any effort to make a clinical diagnosis to explain these symptoms, the prescription of treatments by a technician or nurse, etc., all warrent the criticisms made. A plea is therefore made for more careful diagnosis and a critical selection of cases for treatment in order that the poor results after treatment with physical therapy be kept down to a minimum. The more common errors are enumerated.

DISCUSSION

DR. BENJAMIN H. SHERMAN (Dexter, Iowa): I believe you will agree with me that the topic of the essayist is timely. It is even more than timely for several reasons. It is just too bad that physical therapy is such an open-minded mode of treatment.

If there is any one thing wherein one can be criticized it is in medical progress. The treatment of disease from the time of Hippocrates down to practically the present time has been overshadowed and covered up by secretiveness and mysticism. For instance, from back in the early days up to practically ten years ago, our prescriptions for patients have been written in Latin. Everything has been clouded whereby the patient did not know what was being done for him. We weren't open to the criticism that we are now, because every patient referred to the physical therapist knows exactly what is being done to him.

The physician could write a prescription in the case of dropsy, for instance, calling for strichnine or some other stimulant, which would be nearer right maybe, where the real treatment might have been better using digitalis. But the patient is actually ignorant of this, and when he goes to another doctor to get relief, if you have failed, they do not know what they have had or anything about it.

That is not so with physical therapy. They know what they have had.

There is one opinion on which I wish to take issue with the essayist. That is in regard to treating certain patients that have been referred to you for any certain type of treatment. I can best illustrate that by giving a case in hand. Not many months ago I had a patient come to me, unrefereed at that, with gangrene of several of his toes. The line of demarcation on the large toe was quite evident. The second toe was quite black, but no line of demarcation had formed as yet. The history of the case was that of an old man, 71 years old, who had no evidence of diabetes. Just what this was due to was then problematical. Nevertheless his first toe was as black as it could be, and the line of demarcation, as I said, was showing up distinctly.

He came to me because he had been referred to the surgeon, and of course I had to bring him back to the

same proposition, that there was nothing in physical therapy for his condition.

That case should have been treated by a surgeon, of course, but he was simply frantic with pain and I had to give him something as an uplift measure. I had heard in a discussion about a year or so ago wherein that type of affection had been treated by diathermy. Against my better judgement I treated this old gentleman with diathermy, and to my surprise, after the third treatment, (I forgot to say that this man had received a grain of morphine to relieve him) the pain disappeared, with the result that he became perfectly well. The toe that was not so far advanced cleared up first and the great toe cleared up later. I saw him the day before yesterday and you couldn't tell from his toes which foot had been affected.

After all, the keynote of our whole medical practice resolves itself into one thing, the rest you can almost guess at, and that is diagnosis.

I recall a serious mistake made by me several years ago when a patient with severe backache was referred to me for treatment. I depended upon the diagnosis that came with the patient. All of my treatments failed, and in the end I suggested a Wasserman test. It came back with a four plus finding. The basis of treatment by any measure is the diagnosis of the patient. While physical therapy is in a great measure symptomatic treatment, the results would in many instances be close to specific if an intelligent diagnosis could first be obtained.

DR. D. KOBAK (Chicago): Dr. Brams is a candid and intelligent critic. He has raised issues that cannot be swept away with an apology. They must be met fearlessly. The evidence is top-heavy against loose and borderline practice in our midst, and we as a jury must render a verdict in favor of his plea for greater therapeutic conservatism, intelligent application of modern diagnostic methods, and a more honest co-operative spirit toward our fellow practitioners and patients. This is by no means an easy task if the experience of the essayist is to be taken as an example. The practice of medicine is still considered an art and physical therapy is still considered by the conservative in our profession as an art that is decidedly radical and fallible. In truth it is so and mistakes of commission and omission has befallen most of us; but they have turned out to be torches of experience that have guided our future conduct toward our patients, with greater certainty. If we are honest with ourselves we will be ethical in our practice. But this does not include intelligence. In the practice of medicine as in other fields of endeavor one finds mental mixtures such as the honest, the stupidly honest, the intelligent and intelligently dishonest and a fractionation of all. All ethical physicians wholeheartedly support the timely criticism of Dr. Brams. The unethical opportunists in our midst will build up a wall of self justification and excuses against these criticisms. Nothing can change a quack except legislative and continuous propaganda.

It is to be regretted that such a large portion of unfavorable experience has fallen on the shoulders of my friend. Fortunately he comes of sturdy, intellectual stock and he has met the issues intelligently.

A recent experience of mine is a parallel to the topic under discussion. One of Chicago's outstanding gynecologists referred a patient to me with the diagnosis of multiple fibroma with secondary anemia and nervousness. He stated over the telephone that it was his opinion that surgical intervention was out of consideration at the time and asked me to give the patient supportive and upbuilding therapy. It was my intention to give the patient general ultraviolet treatment. Prior to the initiation of any such treatment it is my routine method to measure the patient's erythema index from a constant distant of ultraviolet radiation, with a simple instrument that I introduced in America in 1925. The patient was advised to report back the next day. She did not do so and I have never heard from her directly since then. After a lapse of several months a nationally known urologist called me up and asked me what treatment I gave to this patient. He informed me that she had come to him with a history of active bleeding and suspected that it was initiated following my treatment. Here is an embarrassing situation. How did the gynecologist react to this experience? How did the urologist react to it and I feel certain as to how the patient reacted. How would Dr. Brams meet this situation? It is needless to say that I lost no time to inform both of the above specialists the facts in the matter.

DR. JACOB GUTMAN (Brooklyn): I was very much impressed by the fact that someone is here to impress upon us the necessity of making a correct diagnosis before any kind of treatment, whether it is medicine or physical therapy.

I had this idea as late as 1909 and thought well enough of it to drop a very excellent income from my office and go abroad and do a lot of work and come back and organize the first diagnostic clinic of its kind in the East. One would feel today that it is unnecessary to dwell upon the point that we must diagnose a case before we decide upon any kind of treatment. Medicine is so far advanced that almost every physician, no matter whether he is in the rural districts or any other place, should do that, and yet we find mistakes in diagnosis made constantly in spite of all the possibilities of good diagnosticians; and these patients are given any kind of treatment.

Only a few days before I left for Chicago a man was sent in with his diagnosis and he was treated for six weeks by men who had been practicing for twenty-two years, and what was the result? We took out a gallon of fluid from his lung. There was so much displacement there that it caused the whole trouble.

About two weeks ago a lady of sixty-six years was sent to a physical therapist. She was treated for

a couple of weeks for chronic arthritis, when it was discovered to be syphilitic.

We can't blame men who live perhaps hundreds of miles away from a good hospital with all their facilities for making an improper diagnosis, but I want to emphasize the point that there is no excuse for men in the city of New York with all the great facilities that anyone wants to have in medicine for bettering diagnosis and treatment. In fact, I find men of this type who have had many years of practice. What is that all due to? Lack of facilities? No. It is just simply due to either lack of knowledge, or you might say they are guilty of poor judgement or neglect, if you want to put it that way.

I only heard a few examples of Dr. Brams which emphasized the use of the physical therapy departments. People are sent in for treatment without the diagnostician knowing about diathermy. They give them this or that. I don't think that is necessary in a city like New York or Brooklyn with every facility at hand. There are men who won't take the trouble, you might say, to make a diagnosis before they start to treat. This carelessness reflects on physical therapy, and that is a very important reason for the attitude taken toward physical therapists in the years gone by. We hope that we shall be able to hear something here which will improve this condition.

DR. JULIUS BRAMS (closing): The point made by Dr. Sherman as to what to do with ones own cases referred for a certain type of treatment, and whether to use your judgement or not for that particular type of treatment, of course demands a great deal of diplomacy with reference to yourself and depends upon the relation between yourself and the referring physician.

If you will just hold to your beliefs I think you will eventually gain tremendously by showing the man that refers the patient that you are willing to lose that particular case or perhaps lose his good will for the time being, rather than do something which in your opinion and experience is not indicated.

I fully appreciate that I am talking to a group of men who have been in practice longer than I, and perhaps men who have been practicing more years than I am old. I don't pretend to lay down any rule for practice, but that is just my opinion and I think most of you will agree with me.

On the other hand, if a patient is referred by a doctor who tells the patient, "You go up and see this man and see whether he tells you any particular form of physical therapy or x-ray is indicated," that brings about a different situation entirely. If that patient comes in and asks for an opinion and not a very definite prognosis, if you are sure you can get results, you can explain to the patient the possibilities and the things concerning the management of the case. However, if you have an example as Dr. Sherman brings up, when you are in doubt as to how much

good your treatment will do, I think there, again, it is perfectly essential that you make it clear to that patient that you are willing to try this type of treatment but that you can guarantee her nothing specific.

In the instance mentioned I think I would have proceeded along these lines: "I will try the treatment that will possibly do you some good. If it doesn't I want you to know that I guaranteed no results."

As to the point Dr. Kobak brought out, of course, accidents in practice happen to every one of us almost

every day, one might say. It is perfectly obvious that Dr. Kobak in trying to be accurate and scientific in procedure brought about a condition which was in no way connected with exposing a few square inches of the patient's skin to ultraviolet. I am sure that the doctor who referred the case to Dr. Kobak knows him and his ability well enough to understand that the little test carried out had nothing to do with producing the internal hemorrhage. You couldn't class him as very brilliant or very bright if he was willing to say that the one little exposure that you gave caused the internal hemorrhage.

:: : THE DOCTOR :: :

*We cannot count how many miles he goes
Through storm and cold and loneliness to bear
The torch of life to one he scarcely knows,
And who his leisure hour may never share.
He speeds through many streets.*

*On either side
The lamps shine out upon the driving snow
The logs are burning in each fireplace wide,
And men find comfort in their warming glow.*

*But not for him the pipe and easy chair;
The book perused beneath the rosy light.
For if by chance he stops a moment there,
The telephone will drive him through the night.
His love must far exceed his hope of gain
Who gives his life to keep us free from pain.*

ANNE CAMPBELL in Detroit News.

PHYSICAL THERAPY CLINICS

THE USE OF RADIUM IN THE TREATMENT OF VERNAL CONJUNCTIVITIS*

I. W. RIGGINS, M. D.

INDIANAPOLIS, INDIANA

Within the past few years several cases have been referred to us from the eye department of the City Dispensary with a diagnosis of vernal conjunctivitis. Most of these patients had been treated by various local applications with no benefit. Usually the condition was made worse. We advised treatment with radium in those cases of undoubted vernal conjunctivitis. The most important point before deciding to use radium in the treatment of eye conditions is an accurate diagnosis, and in every case that was left to the ophthalmological department.

Vernal conjunctivitis usually occurs in children under 15 years of age, and seems to be more common in males than females. Both eyes are usually involved. This form of conjunctivitis occurs most frequently in the spring and summer months, although one of our severe cases occurred in a student of 21 years of age in the winter. The disease is evidently not contagious.

The questions of symptoms and diagnosis we shall leave to the ophthalmologist. Our purpose is to discuss the treatment of some typical cases with radium. That the prognosis in these cases is more favorable since the use of radium has become generally recognized is apparent from the reports of Posey, Pancoast and Jackson. We have used radium tubes in the treatment in all cases and in no instance did we get a reaction sufficient to cause more than a temporary discomfort to the patient. In one case that required a rather vigorous treatment comparatively a few of the eye lashes dropped out, but their loss was only temporary. It was

not necessary for these patients to change in any way their daily routine.

Our method is to avert the lids after cocaineization and treat the conjunctival surface involved, avoiding any undue exposure of the eye ball. Radium tubes containing $12\frac{1}{2}$ to 25 mg. are applied evenly over the affected area for a period of 8 to 18 minutes. The tubes are not screened and are held with forceps to protect the hand of the operator from undue exposure to the rays. The reaction following this dosage is rather mild and subsides in a few days. The redness of the conjunctiva becomes less marked and the granulations undergo a process of retrogression. The burning and lacrimation are noticeably improved within 10 to 14 days. We try to keep the treatment within safe limits so as to prevent the formation of too much cicatricial tissue.

These cases were treated during the height of the disease but there was but little added discomfort, and that only temporary. There were eleven cases in the series. The following case reports are typical:

P. W., Age 21. Dental student referred by Dr. C. P. Clark, December 1, 1926 with a diagnosis of vernal conjunctivitis of three or four years duration. Treatment had consisted of the use of argyrol, picric acid and zinc, but his eyes became so bad that he could no longer do the necessary reading in connection with his dental work. The upper lids were exposed to the unscreened rays of 25 mg. of radium for a period of fifteen minutes and the lower for ten minutes. There was some reaction and a few

*Read at the seventh annual meeting, American College of physical Therapy, Chicago, Oct. 10, 1928.

of the eye lashes fell out. The reaction persisted about ten days after which the burning and irritation rapidly disappeared. He pursued his work in dental school in comfort. On February 4th each lid was again exposed to 25 mg. of radium for a period of ten minutes with no screening. This caused but a slight reaction which soon passed away. He finished the school year with no further discomfort and no trace of the trouble manifested itself. Unfortunately he was killed last summer in an airplane accident. Up to that time he had no further trouble.

F. B., female, age 7. Schoolgirl referred by Dr. Clark April, 1924, with a well marked case of vernal conjunctivitis involving the lids of both eyes. She had been treated by various local applications over a period of about three years with no improvement. Thirteen mg. of radium, unscreened applied for ten minutes to each lid constituted the only treatment. Reaction was slight and improvement prompt. Examination made within the past week showed no signs of her former trouble. This patient we treated three years ago. There has been no recurrence of her trouble and no necessity for further treatment.

Daniel L. and Henry O., aged 8 and 9 years, colored males. Had been treated for the past three summers for catarrhal conjunctivitis with zinc lotion, and other antiseptic but irritating medication. The treatment had caused more discomfort than the disease, so the patients would permit considerable time to elapse between calls at the dispensary. When examined in the spring of 1927 a diagnosis of vernal conjunctivitis was made. The first boy, Daniel L., received the exposure of ten minutes to each eye lid from 13 mg. of unscreened radium. He has been free from discomfort since. The second boy, Henry O., required three exposures. These had the palpebral form with a few thickened nodules about the limbus of each eye.

J. W., 17 years of age. Student, private patient of Dr. Clark, who referred him to me for radium treatment. Left eye began to burn and itch during summer of 1926. Was treated by palliative measures that summer. With the onset of cold weather the symptoms abated and

required no further care. The irritation of the left eye recurred in a more severe form the next spring, became worse in the summer and fall, but began to abate with the onset of cold weather. In the spring of 1928 the left eye began to give more trouble to him as the left eye had two years before. Examination disclosed vernal conjunctivitis mild in the right eye, severe in the left. There was some tenacious irritating mucoid discharge. The tarsal conjunctiva was covered with fleshy growths demarcated to represent cobble stones, but no bulbar conjunctival thickening. There was the usual pale appearance of the conjunctiva of all the lids.

July 7, 1928, 25 mg. of radium to left lid unscreened for eighteen minutes and 13 mg. to right eye for fifteen minutes was applied.

August 5, 1928, 25 mg. was applied to upper lid for six minutes. His discomfort disappeared and the eyes have given him no further trouble.

SUMMARY

1. The results of treatment depend upon the correctness of diagnosis. This should be made by an ophthalmologist who is familiar with the disease.
2. Treatment may be instituted at any stage of the disease, care being exercised not to *over heat*.
3. Complete relief from symptoms can be obtained in practically every case.

DISCUSSION

DR. C. P. CLARK (Indianapolis, Ind.): You have heard the treatment of vernal conjunctivitis by radium and with your permission I should like briefly to review the disease.

Vernal conjunctivitis, commonly called spring catarrh, is an unusual form of chronic conjunctivitis. It is often mistaken for chronic catarrhal conjunctivitis. It is characterized by an epithelial and connective tissue overgrowth of the conjunctiva, but never becomes malignant.

With regard to the symptoms of the disease, one of the characteristic things in making a diagnosis is the history of the patient. The eyes burn at the onset of warm weather and continue so throughout the summer and into the fall.

It is practically always bilateral. In one instance Dr. Riggins has mentioned, we thought we had a case of unilateral conjunctivitis which would be very unusual. After careful observation of the other eye we came to the conclusion that it was beginning to show vernal conjunctivitis too after three years. There are three types: The tarsal type when it is limited to the tarsal conjunctiva; the limbal type when limited to the limbus about the cornea; and the mixed type of the two. The etiology is unknown. It is supposed to come from some alteration in the calcium content of the blood stream. That has never been substantiated. Others say that light has something to do with the onset of the disease.

We must differentiate between four particular conditions: Trachoma; the chronic catarrhal forms of conjunctivitis; phlyctenular conjunctivitis; and conjunctivitis of hay fever. I think any one watching a patient for a short time will not mistake vernal conjunctivitis for any of those four conditions. Chronic catarrhal conjunctivitis, as I mentioned in the beginning, is often mistaken for vernal conjunctivitis.

With regard to treatment, we find that most of these patients have tried all sorts of remedies.

The only thing we had previous to the time of radium was a palliative treatment and it was up to each man's ingenuity to work out something. The main thing that has been found for treatment has been holocain-adrenalin in various strengths and combinations. Another treatment to be used for palliative treatment is a very diluted solution of acetic acid. Again you are only treating symptoms and are not treating the disease.

The disease runs its course from ten, twenty or thirty years or the life of the patient. Fortunately, it never impairs the vision.

The last report in the treatment of this disease is the use of radium. The use of radium in vernal conjunctivitis is one illustration of having found first a cure for the disease before we knew the cause. It does stop it in practically all cases; at least, it will greatly relieve the patient. The most important thing to observe is never to produce too great a reaction. Should you do so, you are liable to have very unfortunate things result, namely, cataract, the onset of glaucoma, an atrophy of the iris, or destruction of the eye. All those things have happened with the use of radium. I am sure that if you never permit too large a dose to be used you will not meet any unhappy experience of that kind.

I am a little inquisitive and I should like to ask Dr. Riggins why radium is supposed to help this dis-

ease. What mechanism is there that brings about the relief? We know in the pathology of the disease that there is a proliferation or overgrowth of epithelial tissue and of connective tissue and that there is a membranous hyalin in the cells, but how does radium bring about this relief?

DR. H. E. FORD (Atlanta Ga.): I wish to thank the doctor very much for this paper. This is a subject in which I have been greatly interested for a number of years. In connection with the clinics in the University School of Medicine these cases were referred to me, so that one man could watch them and study them from one year to the other. Our cases, with one exception, ranged from 5 to 18 years. We had none more than 18 years of age. One colored girl in south Georgia was seen who was 22 years old.

The type which affected the upper lid and tarsals averaged about three to the types that affected the conjunctiva purely corneosclera conjunctivitis on the average of about three to two.

We noticed that a few of these patients would come back in the spring. By vaccinating them or by testing them out with different pollens we found that every case, which had gelatin ulcerations around the cornea and had the pigmentation which is characteristic, reacted to some pollen, either spring or fall. With that as a clew we decided we would immunize these the following year before the attack, with the result that a large percentage (I haven't my records with me) of these were permanently relieved by building up their immunity to certain irritants or certain pollens.

As for the cobblestone type (and personally I believe the two diseases are just as separate and distinct as typhoid fever and measles; one is one thing and the other is another), it had absolutely no effect on these, but they were referred to our radium department and treated, and every one of them was greatly relieved and a large majority of them were cured either the first or the second year.

DR. I. W. RIGGINS (Indianapolis, Ind.): In answer to Dr. Clark's question, as I see it, the short radium rays cause a mild endarteritis of the blood vessels and exudative granulations of the eyelids which in turn cause a retrogressive change in the tissue. In other words, a soft, atrophied, flexible scar displaces the excessive epithelial tissue which makes up the condition.

I just want to emphasize that there are two things to be particularly noted in the treatment of this disease: First, not to overheat it, and secondly, that the radium should be used only with a thin screen.

EDITORIAL

ARCHIVES OF PHYSICAL THERAPY, X-RAY, RADIUM

Eighth Annual Meeting,
November 4, 5, 6 and 7, 1929,
Hotel Sherman,
Chicago.

INFLUENCE OF ULTRAVIOLET IRRADIA- TION ON THE PRODUCTION OF SKIN CANCER

This writing is occasioned by the experiments of Dr. G. M. Findlay of the Imperial Cancer Research Laboratories of London. These experiments are of great scientific interest, but have caused unnecessary panic on the part of physicians and lay people, on account of the groundless deductions which have been made by inexperienced and prejudiced workers. As one medical editor has put it: "The results obtained by his (Findlay's) experiments, no one, of course, can dispute, but in the case of the deductions and especially the inferences, there is a body of evidence of various kinds which prevents one accepting many of these without a great deal more experimental and statistical evidence."

Findlay's investigations are based on the fundamental observations of numerous authorities, the earliest being Unna (1896), who contended that prolonged exposure to the weather and sunlight results in keratosis and precancerous condition, with the frequent occurrence of skin epithelioma. On the strength of this early belief and others quoted, Findlay states that the facts strongly suggest that sunlight and more especially ultraviolet light, may play an important part in the genesis of skin cancer. It is admitted that no case of skin cancer due to the therapeutic use of ultraviolet light has yet been reported, but citation is made of a case by Colquhoun (1929) who observed multiple keratoses on the chest of a man aged 27 years, who had received

quartz light therapy for some eighteen months. Cheatle, on the other hand, has noted that in skin bronzed by therapeutic exposure to sunlight there is very active mitosis in the epithelial cells situated above the basal layer.

The experiments were performed by Findlay to determine (experimentally) whether ultraviolet light had any carcinogenic action on the skin. The original report can be found in the November (1928) issue of the *Lancet*.

In a subsequent number of this same periodical, the same author attempts to clarify some points which evidently were not brought out in the first article. He stated that there was no relation between ulceration and the subsequent growth. The growth occurred on skin, which either appeared normal or atrophic. Experiments with a thermopile showed that under the experimental conditions the rise in temperature is not greater than 5° C. Exposure of mice to a considerably higher temperature than this for eight months has up to the present failed to induce cancer. From this it is concluded that the cancer is not produced by heat in the same way as Kangri cancer. Experiments are now being carried out with filters to ascertain more definitely the wave length of the cancer producing rays.

The conclusions drawn by Findlay as a result of his studies are: (1) by exposure of mice to ultraviolet light for a period of not less than eight months it is possible to produce papillomata and malignant epitheliomata of the skin; (2) when mice are tarred and exposed to ultraviolet light at the same time, the period necessary for the induction of cancer is shorter than when either tar or ultraviolet light alone is employed; (3) a series of mice tarred for one month failed to develop cancer, but when tarred and exposed to ultraviolet light for the same period, three mice developed malignant growths.

It must be stated that while the precise conditions under which the experiments were con-

ducted are clearly described by Findlay, these are not included in writings which have appeared with a view of bringing condemnation on ultraviolet light therapy. This point is stressed by the medical editor in the *British Journal of Actinotherapy and Physiotherapy*, who states further, "Translating the experiments into human terms, they might be taken as roughly representing what would happen were the skin of a man to be shaved on an area some six inches square, tarred twice a week, and subjected to the light of a powerful mercury vapor lamp three or four times a week at eighteen inches or more, were the lamp correspondingly large, for twenty or more years. This, no doubt, would also produce carcinoma if the patient survived, but such a procedure would have little bearing on the short exposures over a limited period used for therapeutic purposes."

The views expressed by experienced clinicians who have employed ultraviolet light for therapeutic purposes fail to substantiate findings analogous to those of Findlay's animal experiments. Reyn, Rollier and O'Donovan have gone on record as failing to observe changes in the skin involving a risk of carcinoma from prolonged ultraviolet irradiations. In this country the literature contains no evidence of carcinomatous development from either natural or artificial ultraviolet light sources. And, while it is true that further experience and investigational work may in time change our present beliefs, we cannot now allow a valuable therapeutic agent to be relegated into the discard because of animal experiments which do not properly bear definite clinical analogy. We must assume a sane viewpoint. Ultraviolet light has met certain needs in the treatment of some human ills. It has so definitely established itself as an aid to other remedial agents, that to become prejudiced to its use on present grounds would be to curtail the progress which has already been made by some of the most constructive researches in medicine during the present century.

A WEEK OF PHYSICAL THERAPY IN LOS ANGELES

The eleventh annual session of the Western School of Physical Therapy will be held at the

Alexandria Hotel, Los Angeles, California, June 17 to 20, under the direction of Dr. Burton B. Grover and staff of instructors.

Following the session of the School, the Pacific Physiotherapy Association will hold its annual meeting at the Alexandria, presenting an excellent program by men of national reputation. These two events will provide the outstanding conferences in physical therapy on the Pacific coast this season, and a cordial invitation is extended to the medical profession, and especially those members who are interested in the progress of physical therapy, to attend these important sessions.

Full information and programs may be obtained by addressing Dr. Chas. Wood Fassett, Hotel Glendale, Glendale, California.

FATAL USE OF AN ULTRAVIOLET RAY APPARATUS

A youth, aged 21, was found lying dead in his bath, which was half filled with water. An ultraviolet ray apparatus was at the side of the bath. Examination of the body by a physician showed that death was due to shock. The apparatus was submitted to an expert on electricity, who reported that the ultraviolet ray apparatus was so constructed that a shock could be received in five ways from it: from the metal case, because of the low insulation resistance of 20,000 ohms, whereas the resistance ought to have been one of several million ohms; from the exposed end of a conducting wire removed from its position on the terminal; from the pressure on the wire guards putting the case of the instrument in direct contact with the heating element; from leakage of water into the appliance, thus completing a circuit through the water in the bath and to the earth through the water pipes; from a damaged lamp in the instrument, and, finally, from the absence of any provision for earthing the metal case. The boy persuaded his mother to let him buy the ultraviolet ray apparatus to remove comedones from the back of his neck. A book of instructions was given with the apparatus in which the user was recommended to apply the instrument in the bedroom

but not in a bathroom, because steam might interfere with the passage of the rays from the lamp. The coroner said the instructions seemed to be a "puff" suggesting that the apparatus would cure every disease that flesh was heir to. There was no adequate warning about the dangers attaching to the use of apparatus through which a house current of 230 volts might be passed. He thought it reprehensible that this appliance should be supplied by a firm posing as beauty experts.—J. A. M. A., 92:571-572, Feb. 16, 1929.

RICKETS—A DECADE OF PROGRESS

With the demonstration in 1919 by Huldschinsky that ultraviolet radiation favorably affected the rachitic state, interest in this classical problem was again revived. A decade of research, unprecedented in the annals of modern medicine, was initiated, which eventually established, beyond cavil, the status of ultraviolet therapy as a specific in the cure of rickets. Aside from Banting's outstanding contribution to the problem of diabetes, no other event has so thoroughly held the attention of modern medicine or engaged the interest of such a large group of brilliant investigators. The rise of a voluminous literature may in some respects be considered as a fair index to the unusual interest manifested in this problem.

With the advantage that time has given us, one can now glance backwards over the events of the past ten years and note the progress that has been made, as well as observe in perspective its evolution, its branching, its ramifications, and marvel at the productive labor that has been brought to bear in the elucidation of this fascinating and important problem. By virtue of the important discoveries resulting from the investigation of this problem, the metabolism of rickets is now better understood; the relationship of the calcium-phosphorous imbalance in connection to faulty ossification is now more fully appreciated, as are the factors modifying its deposition in uncomplicated human rickets. A few years ago the relationship of rickets and vitamin deficiency was clouded and relatively unknown. Shortly following this intensive research the vitamin factor was definitely recognized as intimately connected with rachitic disturbances. Pacini, in 1921, and Hess, in 1922, were probably the first American investigators to call our attention to the specific relationship

that existed between it and ultraviolet radiation.

With the establishment of this fact it was but a step to demonstrate that cholesterol and phytosterol acquired active antirachitic properties on irradiation, and that the photochemical effect was due to absorption. The connection between vitamin D and ultraviolet light absorption became apparent to several independent investigators at about nearly the same time. Hess, Steenbock and Drummond and their co-workers in their published reports about 1925, demonstrated by laboratory proof that cholesterol showed well defined bands of absorption in certain portions of the ultraviolet region. Many ingenious explanations have heretofore been advanced by various authorities with reference to the phenomena of radiant energy absorption in animals. The explanations varied from the fantastic to the fanciful. Some attributed a special intelligence or intuition that was awakened in animals only in the presence of ultraviolet radiation.

In this connection Sonne offers a logical explanation based on actual experiment. In an article published elsewhere, Sonne demonstrated by a series of careful controls that the furry integument of animals definitely acted as a barrier to the radiant energy, and that the anti-rachitic effect was produced in an indirect fashion rather than by direct absorption. He proved that it was through the activation of the fat-like material that is always associated with the hairy portions of the animal and the swallowing of the radiated product that promoted the anti-rachitic changes. Specimens of rachitic animals so fixed that they were unable to lick the irradiated hairy parts remained rachitic and died.

The cholesterol as the inciting antirachitic factor was soon discarded when both Rosenheim and Webster in 1926 and Heilbron, Kamm and Morton, 1927, independently discovered the presence of traces of impure material, identified later as ergosterol. Vegetable sterols have since then been found capable of similar activation. An avenue of interesting possibilities in food irradiation has thus been opened. The utilization of irradiated material for food purposes has recently been indicated by Steenbock.

Although the past decade has seen an unusual development in the interest of ultraviolet radiation in connection with the problem of rickets, indications from present unpublished laboratory researches are that the next few years will see equally astonishing contributions. It is

relatively safe to predict that other portions of the electromagnetic spectrum will be utilized in the activation of vitamins—at least this is now certain with reference to the vitamin D factor. There is now existing proof that infra-red, visible light, diathermy, roentgen and cathode rays agencies may be successfully utilized in the activation of vitamin D in foods and animals. Radiation therapy is still in its incipiency, but it is logical to believe that its possibilities are far from exhausted. From the progress already made there is specific indication that treatment

of rickets and its allied disorders will in the near future be definitely modified from that utilized today. Variability in the potency of the nauseous cod liver oil may force the medical profession to adopt ultraviolet radiation as a superior substitute. A step in this direction is the now cautious prescription of activated ergosterol (Windaus and Hess) as a substitute for the more expensive method by direct irradiation. Activation of foods and radiation of drugs appears to be the next problem that calls for solution, and this is the next step in future research. D.K.

THE STUDENT'S LIBRARY

BOOKS REVIEWED

HANDBUCH DER LICHTTHERAPIE. Written and edited by *W. Hausmann and R. Volk*. With 106 illustrations and thirty-six charts in text. Julius Springer, publisher, Vienna, 1927.

The authors in their preface state that they were prompted to publish this book because of the desire to gather all of the modern conceptions on the theories and practice of light therapy into the confines of a single volume. An effort was made to include the different "Schools" of light therapy and summarize, as it were, all of the existing views into a composite picture. The volume is separated into a general and clinical division. The first deals with general theories wherein all of the bio-physical phases of the subject are splendidly discussed. Each chapter is separately dealt with by a selected authority who discusses his particular subject in a terse and intelligent manner. An extensive bibliography is usually found attached to the end of each chapter, which gives it a very rich inspirational background. As an example, the pioneer of modern heliotherapy, Bernhard, wrote the chapter on the historical development of light therapy. The historical facts are presented in a scholarly manner and without any padding. Bernhard has been a source-book for many an aspiring author on light therapy. Prof Exner of Vienna wrote the section of the physics of solar and sky radiation, and Prof. Hauer the two chapters on radiant light sources and the measurement of ultraviolet. This is a technical exposition on the related physics of light radiation, and is liberally illustrated with charts and pictures. It is suspected that the clinician who so readily avoids technical subjects will pass over this very important portion to his great loss. It will, however, be an exhaustive source of information to the student seeking fundamental information. Prof. Hausmann, as may be expected from such an authority, deals with the general fundamentals of light therapy in a scholarly fashion. The exposition is not technical, but it nevertheless manages to give the reader a good survey of the subject. We suspect that Hausmann so fashioned his literary style to attract the large body of clinical

of Vienna on the effect of light on normal and diseased structure. It is liberally illustrated and will prove to be a source of rich information to the student of phototherapy. A tremendous amount of scientific material is included herein. Strandberg, of Copenhagen, closes the theoretical division of the volume with a detailed discussion on the theories of modern light therapy, the various methods employed and the relative efficiency of the known apparatus utilized in modern practice.

The clinical section is written by outstanding authorities. Bernhard discusses methods and use of heliotherapy in surgical diseases. Chievitz, of Copenhagen, discusses similar conditions from the viewpoint of its treatment by local and general carbon arc therapy. Huldschinsky, of Berlin, deals with the prophylactic and therapeutic application of light in pediatrics, and Volk, of Vienna, exhaustively discusses various phototherapeutic measures in dermatology. Other conditions are discussed by representative authorities such as Laquer, etcetera.

Here is a book that is a veritable storehouse of information on light therapy. The associated authors were carefully selected because of outstanding experience in their respective specialties. The book may be likened to an abbreviated encyclopedia on the subject. The book is highly recommended. Its translation into the English language is urged because it is deserving of a wider reading clientele.

NOTES ON CHRONIC OTORRHEA. With special reference to the use of zinc ionization in the treatment of selected cases. By *A. R. Friel, M. A., M. D.* (Univ. Dub.) F.R.C.S.I. An Asst. Aurist to Tottenham, Hornsey, and Walthamstow Educational Committees. With fifty-four illustrations. Bristol. John Wright and Sons, Ltd. 1929.

Any therapeutic method which has been demonstrated to be of value in chronic otorrhea merits familiarization by the otologist and the general practitioner. Pioneering a method of any kind often proves

who are open minded enough to thoroughly test it and judge it according to the results achieved. The author of this little volume has, for more than a decade, written upon the subject of zinc ionization in purulent otitis media. His intensive study of the method and its application in large series of cases have enabled him to perfect the technic so essential for success with any electrotherapeutic procedure.

In the preface, acknowledgement is made at once of the work of Professor Leduc, of Nantes. The author then expresses in a few sentences the scope of his writing. "This book is devoted to the consideration of a local disease—chronic otorrhea. It tries to answer two questions: (1) How is any particular case of chronic otorrhea to be treated? (2) How are we to deal in an economical manner with the large number of cases needing treatment among elementary school children in the large towns?"

There are three sections. Part one deals with the role of the electric current and zinc ions in the treatment of septic surfaces. Part two considers conditions in the ear in chronic otorrhea and the technique of treatment, while part three includes a chapter on the importance of policy and of organization.

The first few chapters discuss the fundamentals and technic of treatment. Then the anatomy of the ear is reviewed, the causes of chronicity outlined and specific steps given for the various conditions which are sometimes present in connection with the major infection. In this part the illustrations are helpful in portraying the author's viewpoint. The tables of results show the accomplishments in classified groups of cases. An important subject considered is that of inaccessible sepsis. In this connection, Friel writes: "Unfortunately, in a good many cases of chronic otorrhea the pus occupies a situation which is either only accessible to treatment from outside with difficulty, or not accessible at all. The latter cases may be dismissed with the statement that, if this has proved to be so, operation is required; almost always a mastoid one."

"When the septic area is accessible but with difficulty, special instruments are required (a) to cleanse the area, (b) to fill the cavity with zinc solution, (c) to distribute the electric current to the walls."

In the final pages of part two, space is devoted to the reproduction of tables summarizing the results obtained in other clinics. It thus seems that the zinc ionization method for chronic otorrhea has been adopted by many otologists, the majority of whom have had success. In this country, a small group who have been progressive enough to investigate the simplicity of the procedure and its favorable results are now staunch adherents of ionization. It seems regrettable that a more general usage has not as yet been observed. With the present exposition of the subject, detailed and comprehensive as it is, physicians now have an opportunity to acquaint themselves with the technic and apply it in their routine work. The author has at the outset em-

phasized that the treatment is intended for selected cases. This conservatism, coupled with the thoroughly scientific effort of the whole presentation, is indeed commendable.

A. R. H.

PHYSIOTHERAPY THEORY AND CLINICAL APPLICATION. By Harry Eaton Stewart, M. D., Director, New Haven School of Physiotherapy, etc., Second Edition, revised, with 92 illustrations, pp. 395. Paul B. Hoeber, Inc., publishers, New York, 1929.

The author of a modern text book in physical therapy has at least two problems to contend with, (1) to include all of the latest and proven facts on the subject, and (2) to correlate this growing mass of information into a concise and clear manner so that it will be coherent, intelligent and attract the interest of the more or less busy practitioner. This is a task of no small proportion. The author of this volume has been cognizant of the difficulties before him, and has in a fairly successful manner overcome this difficulty. He has reduced mathematical and technical discussions and has abbreviated many of the theories associated with this new discipline into a short but intelligent summary. By so doing the average reader receives predigested information of a sort, but the scholarly and scientific qualities of this study is reduced to a system of dogmas. The serious minded student is left with no choice of free speculation, or the benefit of the vicarious thrill that is his when he personally reviews the scientific efforts of his fellow man. A measure that has partially overcome this objection is the inclusion of a short bibliography at the end of the text. The book is divided into two sections. The first deals with the theory and the latter with its clinical application. The author's literary canvas is so extensive that of necessity the subject matter is dealt with in a sketchy manner. He has, however, done exceedingly well with his material. Wherever possible the subject is introduced by an historical sketch, followed by a concise definition, a physical interpretation of the measure utilized, together with an interpretation of its physiological effect. The technic of the various agencies is discussed in an intelligent manner and their limitations are indicated. The clinical section is treated in a manner commensurate with the author's experience. The chapter on muscle training is a welcome addition. The book is well gotten up, the type is clear and the exposition is concise and comprehensible. It is one of the best introductory books on physical therapy in the English language.

RECENT ADVANCES IN CHEMISTRY IN RELATION TO MEDICAL PRACTICE. By W. McKim Marriott, B. S., M. D. Pp. 141. Illustrated. Price, \$2.50. C. V. Mosby Company,

This book is made up of a series of lectures given before the San Diego Academy of Medicine, 1927, and takes up the following subjects:

Fundamental Chemical Considerations which discusses the atomic theory, the nature of molecules and emphasizes the unique properties of the hydrogen ion.

Second chapter is divided between Acidosis and Alkalosis and gives a discussion of hydrogen ion concentration and a discussion of the reaction of the blood and methods of maintaining it. Ketosis is also discussed along with methods of treatment of acidosis and alkalosis.

Third chapter has to do with Chemistry of the Blood. The fourth and fifth chapters to Foods and Metabolism, the fifth going into an extended discussion of vitamins and their influence upon body metabolism. The sixth chapter discusses the various endocrines and hormones.

The style is interesting reading. The format of the book is pleasing and attractive. Material contained therein is exceedingly valuable and should be in the hands of every physician and student.

AN OUTLINE OF ROENTGENOLOGY. A study of the uses of the roentgen rays in practice, research and teaching, by *Professor G. Holzknecht*, Vienna. Copyright by Julius Springer, Vienna.

This booklet, dedicated by the author to all physicians interested in roentgen rays, is an outline of the value of the rays in medicine. Professor Holzknecht is himself a pioneer in this field, and startled the medical world with his discoveries in diagnosis and therapy which began thirty years ago.

The author has seen the science of roentgenology develop until it now occupies a prominent place in medicine, as an aid in diagnosis, treatment, research and teaching. In this book he collects the views on the status of the various branches and expresses his own opinions.

In the first chapter the relation of roentgenology to medicine is discussed. Then follows a chapter on specialization. The science is divided into its various branches, each of which is outlined in detail.

The training of roentgenologists and technicians, their qualifications and courses of instruction are thoroughly discussed. Finally the author presents his views on the place which roentgenology should occupy in the medical curriculum, in undergraduate study, post-graduate work and research.

To anyone interested in x-ray work, and especially to the roentgenologist, the book should prove an inspiration and stimulus toward greater accomplishment.

—Aaron Arkin.

INTERNATIONAL ABSTRACTS

The Treatment of Epithelioma of the Penis by Radiotherapy and Electrocoagulation. G. E. Pfahler and B. P. Widmann. *Am. J. Roentgenol.*, 21:25-13, Jan., '29.

This study is based upon a review of 10 cases of carcinoma of the penis, and one case in the terminal stage of ulcerating carcinoma in the groin, following amputation and resection. Of the 10 cases, 9 are free from any gross evidence of cancer twelve and seven years, eleven months, seven, three and a half, five, zero, three, three, and one and three-fourths years after beginning treatment. In the cases which we treated with radium alone we did not cure the primary disease. Roentgen treatment would be expected to do even less. The high voltage roentgen treatment was effectual in controlling the palpable lymph nodes, and in causing the disappearance of recurrent nodules in the perineum and groin (five years).

It would seem that one cannot depend upon irradiation alone to cure the primary cancer of the penis, except in the very early lesions. If enough radiation is used to cure the disease in an advanced case, there is

likely to be a secondary necrosis due to an endarteritis caused by the irradiation. The apparent cure of 90 per cent of the cases by a combination of amputation by electrocoagulation and irradiation would seem to be sufficient to recommend this form of treatment. It has been observed also in cancer elsewhere that irradiation is at times more effectual on the lymph nodes and the recurrent nodules than on the primary lesion. The permanent cure (five years) of an extensive, rapidly recurrent case, would indicate that irradiation should be used as postoperative treatment in all cases.

Radium Therapy of Cancer at the Radium Institute of Paris. C. L. Regaud. *Am. J. Roentgenol.*, 21:1-24, Jan., '29.

The progress of radiotherapeutic methods cannot be judged by temporary regressions but only by statistics of cures based upon indisputable data, which are periodically brought up to date and followed over a sufficiently great number of years. Radium therapy through natural cavities of the body cures with reg-

ularity only epidermoid carcinoma of the cervix uteri, and only when the cancer has not as yet extended far beyond the limits of the uterus, i.e., cases of the so-called first and partly of the second stage. In cancers which are more extensive this procedure can be used only as an addition to irradiation from an external source. In other localizations of cancer, intracavitory radium therapy usually does not result in more than temporary diminution of the tumor. Homogeneous irradiation from radiating sources for interstitial radium therapy may best be obtained by numerous foci of weak individual strength, with filters which permit the penetration of gamma rays only. Radium puncture with removable platinum needles which may be inserted directly into the tissues seems to be the simplest and the least evil of these. At the Radium Institute of Paris radium puncture has been reserved for the past few years to a small number of localizations, especially cancer of the tongue.

Radium surgery we consider as a procedure which should be used only exceptionally; we employ it principally for the treatment of massive cancers of the facial bones, especially antrum cases. Surface radium therapy, as carried out at the Radium Institute of Paris is applied with the aid of wax molds which permit fields of radiation with regular isodose surfaces. Series of the interchangeable radium tubes constitute the radiating surfaces on the external aspect of these supporting molds. The radiating surfaces may thus be varied in form, dimensions and strength. This procedure gives excellent results in epitheliomas of the skin. When it becomes necessary to have focal distances over 3 cm., hollow wax molds are employed so as to make them lighter in weight. The efficacy of this method has not yet been determined in cancers which extend 5 cm. below the surface or more; especially in cancerous adenopathies.

For distances of application which are 6 to 8 cm., the great size and potent charge of the radiating focus necessitates protection of lead walls, the weight of which cannot be supported by the patient. Radium therapy at a distance which then becomes necessary calls for arrangement for the support of the radiation focus and its protecting screen. An apparatus containing 4 grams of radium has been employed at the Radium Institute of Paris since 1925. Its radiating surface measures approximately 150 sq. cm.; the focal distance is 10 cm. and 1 mm. platinum used as filter. The large-sized opening for the beam permits each part of the radiating focus within this surface to have a great radius of its radiation utilized. Large entrance fields on the skin facilitate the concentration of uniform radiation intensity in extensive neoplastic zones. The isodose surfaces are practically plane and the volume dose can be easily determined.

The varying radiosensitivity of cancers is of the greatest importance. Progress in technic of radiotherapy has brought striking evidence of the inequality in sensitiveness of various cancers by eliminating certain causes of error. The only cancers which have been cured regularly by radium therapy are cancers

originating from epidermoid structures. The number of successful treatments is reduced by anatomic-topographical difficulties of some localizations, for instance in cancers of the esophagus. Adenocarcinomas are in general more radioresistant than the neoplasms just mentioned. At the Radium Institute of Paris we have been unable to cure, by selective radiotherapy, adenocarcinomas of the rectum or cervix uteri except in a few rare instances.

The principal radiation effect on cancer cells is not an indirect injury. Variations in the abundance of leukocytes, and lesions in the vascular and connective tissues of the irradiated areas are inconstant and late. Lesions of radiosensitive cells are early and constant. Direct cyto-lethal action of radiation is, therefore, the essential phenomenon in the treatment of cancer. It cannot be assumed that there exists a fundamental difference between normal and cancer cells from the standpoint of radiophysiology.

Gamma rays of radium have an undoubted biologic superiority over our present day roentgen rays. This superiority results from a selective action which is especially defined in its biologic effects on radiosensitive cells. Nevertheless, it is possible that the inferiority of roentgen rays is only temporary and that increase in their penetration power will reverse this relation.

Effects of Massive Doses of Irradiated Ergosterol. I. J. Klein. J. A. M. A., 92:621-622, Feb., 23, '29.

Massive doses of irradiated ergosterol fed to albino rats caused anorexia and loss of weight with impairment of the general physical condition and the rate of growth. The blood calcium concentration was 50 per cent higher than that of the control animals and those fed cod liver oil, while the phosphorus remained approximately the same. The protein concentration of the serum of the animals given ergosterol was less than that of the animals given cod liver oil, while the albumin globulin ratio was higher than that of the animals fed cod liver oil.

Radiation Therapy in Gynecology. I. I. Kaplan. Radiol. Rev., 51:62-65, Feb., '29.

Radiation is a really helpful means of treating many gynecologic conditions. It is not a panacea for all lesions, nor is it the method or choice in the treatment of all conditions, but when properly, judiciously and carefully used, radiation is a potent factor in the care of the gynecologic patient.

The radiation therapist and the gynecologist must cooperate, and surgical judgment must be followed in deciding the course of treatment. The role of the radiation therapist is not an easy one in the family of medical specialist, but if he will constantly co-operate with the gynecologist, and treat each case as an individual entity, using the judgment of his colleague with regard to the course of treatment to be pursued, the results that will be obtained will prove highly gratifying to all concerned.

Diaphragmatic Hernia. W. E. Hunter. *Radiol. Rev.*, 51:66-75, Feb., '29.

Diaphragmatic hernia is much more common than it is thought to be and often overlooked by the physician or surgeon, the diagnosis being made by the roentgenologist or at autopsy.

It is most often congenital and may occur at the natural openings of the diaphragm or at weak spots in the diaphragm, due to either improper development of the musculature or failure of the stomach to descend and mechanically prevent fusion of the diaphragmatic segments.

Eventration is a congenital weakness of the diaphragm, and may be due to failure of the lung to develop properly and push the diaphragm down. Non-rotation of the stomach is frequently associated with this condition. It may also be acquired from degenerative changes in the musculature or injury to the phrenic nerve.

Irradiation Treatment of Carcinoma of the Cervix Uteri. C. C. Norris. *Urol. and Cutan. Rev.*, 33:77-78, Feb., '29.

Carcinoma of the cervix uteri results in a 50 to 60 per cent five year mortality despite any form of treatment. Radical operation and irradiation are the only two methods which have been found satisfactory.

The Coincidence of Hyperplasia and Endometri and Carcinoma Corporis Uteri. C. F. Fluhmann and H. A. Stephenson. *Surg. Gynec. Obstet.*, 48:425-428, March, '29.

A study of the literature shows that only a few cases of hyperplasia of the endometrium associated with malignancy of the body of the uterus has been reported. This coincidence is thus regarded as very unusual. A case is described in which abnormal bleeding occurred in a patient at the menopause. The histopathological examination of the uterus showed an early adenomatous cancer arising in the superficial layers of hyperplastic endometrium. All the malignant tissue was apparently removed by the curette. The hyperplasia was accompanied by an adenomyosis uteri.

An Outline of the Diagnosis and Treatment of Toxic Goiter. L. W. Rork. *Nebr. St. Med. J.*, 14:78-80, Feb., '29.

The records of three large goitre clinics show cure between 70 and 80 per cent of cases operated. At the time of this writing statistics show the results of roentgen therapy as to cure, improvement and absence of relapse at least equal to those presented by any other method. The author reports a 65% to 80% cure in cases treated by roentgen ray. This fact is attributed to the fact that usually it is the inoperable cases which are referred to the radiologist.

The author urges a more standardized method of preparing the statistics on results of the various treatments of toxic goitre.

Treatment of Uterine Carcinoma. G. G. Wilkins. *New England J. Med.*, 199:1154-1163, Dec., '28.

Usually there is unnecessary delay, and sometimes inexcusable delay, in diagnosing cancer of the uterus. This unfortunate condition can be prevented by instructing female patients to report irregular bleeding, and by promptly examining all patients presenting themselves with such symptoms. Cancer of the fundus uteri can be cured with radium, and as a therapeutic agent will be used more in the future than in the past. Radium is the method of choice in treating cancer of the cervix. In the series reported in this paper, the extent of involvement included the early type, the borderline and advanced cases. Six and five-tenths per cent of these unselected patients treated 3 or more years ago with radium alone, are living and free from recurrence. Thirty-seven per cent of the patients treated five or more years ago are living and free from recurrence.

Diathermy in the treatment of Gonorrhoeal Conditions. P. Pediconi. *Urol. and Cutan. Rev.*, 33:75-76, Feb., '29.

The first treatment of diathermy to gonorrhreal arthritis was introduced by Eitner in 1909. Gonococcus is susceptible to heat as is proven by the fact that there is a cessation of gonorrhreal discharge in patients when there is a supervention of fever. Boerner and Schmidt had very good results in the application of diathermy in gonorrhreal patients in those cases which were chronic. Acute cases did not respond to this treatment. The author has had very good results in treating females, but suggests that it would be much more difficult to apply this treatment in males.

Five Year End Results of Treatment of Uterine Carcinomata with Radium and X-rays of Varying Voltage. H. Schmidt. *Am. J. Physical Therapy*, 5:443-446, Jan., '29.

The progressive changes in the technic of deep radiation therapy with voltages of 110,000 to 211,000 and varying factors have been discussed, and the factors for each period have been given. A comparison of the five year good end result percentages of radiation treatment of cervical carcinomata for each period has been made and the conclusion drawn that the short wave x-ray therapy gives a better five year good end result percentage than the cases treated with x-rays of a voltage of 110 or 140 kilovolts. Radiation treatment of recurrences of cervical carcinomata after surgery offers very little hope for five year good end results except the recurrences which are strictly localized in the vaginal vault and are freely movable. The latter are placed in Group R1 of the recurrent table. High voltage x-ray therapy represent, therefore, a decided advance in the treatment of carcinomata of the cervix in combination with radium. The percentage of five year good end results have thereby been im-

proved from about 14.02 with the low voltage x-rays to 20.32 per cent with the high voltage x-rays.

Roentgen and Radium Treatment of Verruca Plantaris. L. R. Taussig and H. E. Miller. *Am. J. Roentgenol.*, 20:514-517, Dec., '28.

Over 80 per cent of plantar warts are amenable to radiation therapy. In using radium a maximum dose should be administered at the first sitting and this should not be repeated more than once. The most satisfactory roentgen ray dose is an intensive application followed by two subintensive treatments at two-week intervals. The keratotic covering should be removed before treatment, but bleeding should be avoided.

The Radio Knife in Dermatologic Surgery. H. J. Templeton. *Calif. & West. Med.*, 30:83-87, Feb., '29.

The radio knife has proven a valuable aid to men in dermatologic surgery, especially in the removal of cutaneous malignancies. It does not supplant, but rather supplements other established procedures.

The Relation of Frequency to the Physiological Effects of Ultra-High Frequency Currents. R. V. Christie and A. L. Loomis. *J. Exp. Med.*, 49:303-320, Feb., '29.

Biological effects of electromagnetic waves emitted by a vacuum tube oscillator have been studied at frequencies ranging from 8,300,000 to 158,000,000 cycles per second (1.9 meters wave-length).

The effects produced on animals can be fully explained on the basis of the heat generated by high frequency currents which are induced in them.

No evidence was obtained to support the theory that certain wave-lengths have a specific action on living cells.

At frequencies below 50,000,000 cycles, the effect of these radiations on animals is proportionate to the intensity of the electromagnetic field. As the frequency is increased beyond this point, the amount of induced current is diminished and the apparent lethality of the radiation is decreased. This can be explained by changes occurring in the dielectric properties of tissues at low wave-lengths.

Tuberculosis of the Cervix Uteri. M. Douglass and M. Ridlon. *Surg. Gynec. Obstet.*, 48: 408-411, Mch., '29.

Tuberculosis of the cervix uteri is an extremely infrequent gynecological lesion. Less than 20 cases of undoubtedly primary tuberculous lesions in the cervix have been recorded. Secondary involvement of the cervix is much more frequent, and the prognosis is less favorable, depending upon the severity of the associated tuberculous foci. Two cases are presented, one of pantuberculosis of the pelvic viscera and a second a presumable case of primary tuberculosis of

the cervix based on the evidence so far obtained. Complete recovery of the patient followed panhysterectomy in the first case.

Fatal Embolus Due to Inflation of Bladder with Air. C. Pierre Mathe. *Surg. Gynec. Obstet.*, 48:429-436, March, '29.

Distention of the bladder or urethra with air or oxygen for any purpose may result in transitory or grave symptoms should it enter the venous circulation. A fatality is herewith reported which was proved at autopsy to be due to air embolism following the inflation of the bladder for an operative procedure. Increased intravesical and intra-urethral pressure is favored by prostatic hypertrophy, as was noted in this case, or by stricture formation, which prevents the escape of air between the walls of the urethra and the indwelling catheter or cystoscope. Rupture of the vesical mucosa by overdistention, or the presence of a pre-existing pathological lesion such as marked inflammation, ulcer formation, or a new-growth weaken the bladder wall thus favoring the entrance of air into the venous circulation. Undoubtedly mild symptoms consisting of restlessness, transient changes in the respiratory and cardiac action have been overlooked, as also the cause of fatal termination in such cases. Death is due to the arrest of the pulmonary circulation, to gaseous distention of the right heart thus preventing function of the tricuspid and pulmonary valves, to little blood reaching the left ventricle, so that anemia of the vital centers of the brain is produced, and to stasis of the coronary vessels. The most effective treatment of air embolus is the immediate release of air pressure in the bladder, artificial respiration, and injection of 2 cubic cm. of 1: 1000 adrenalin solution directly into the right heart.

Air in the bladder and urethra should be used with the greatest caution. Inflation of the urethra and bladder with air for diagnostic, therapeutic, and operative procedures should be abandoned and harmless sterile water or mild antiseptic solutions substituted.

Giant-Cell Tumor of the Upper End of the Femur: Report of Three Cases. M. S. Henderson. *Radiol. Rev.* 51:13-20, Jan., '29.

Three cases of giant-cell tumor in the upper end of the femur are presented which are somewhat unusual. In the first case symptoms had been present for only seven months and the tumor was excised during the active period of the growth, when the vascular mass within the cavity could be scooped out, the lining destroyed by curettage and the side walls crushed in. Roentgen-ray treatment will be carried out when the cast is removed six weeks from the time of operation.

The second case showed the terminal cystic stage of the disease. Bony union has ensued after a stormy convalescence complicated by fracture. The third case showed the tendency to recurrence. It is probable that enough of the upper end of the bone was not re-

moved to include the limiting membrane that was present in these tumors, and which walls off the tumor from the rest of the medullary cavity. The two patients who had active trouble were below par, with low hemoglobin, whereas the patient in the terminal stage was in robust health.

Quartz Lamp Therapy in Human Rickets and Rachitic Spasmophilia. H. J. Gerstenberger and J. I. Hartman. J. A. M. A., 92:357-368, Feb. 2, '29.

Observations in thirteen rachitic and spasmophilic infants show that weekly exposures to the ultraviolet rays produced by the quartz lamp in doses of 1 erythema unit as determined by the method of Rost and Keller for colored infants, and less for white infants to both front and back, bring about healing in practically the same time required by the heavier schedules at present generally used.

Because of the simplicity and economy of this arrangement and because of the slight change that is produced by such exposures to the skin, the adoption of this schedule as a routine procedure in the cure and prevention of rickets and rachitic spasmophilia by the employment of the ultraviolet rays is recommended.

No increase in spasmophilic symptoms and no lengthening of the time period at the end of which the cathodal opening contraction level was greater than 5 were observed in rachitic infants manifesting spasmophilic symptoms as a result of the use of the quartz lamp schedule followed by us.

A Review of the Roentgenology of the Urinary Bladder. Prof. M. Juhl. Radiol. Rev., 51: 1-3, Jan., '29.

The newest branch of roentgenology is its extensive application in urology. It is capable of superseding cystoscopy. The author describes the characteristics of tumor, diverticula and tuberculosis of the bladder as they appear on the film.

Calcium and Inorganic Phosphorus in the Blood of Rabbits. W. H. Brown. J. Exp. Med., 49:103-126, Jan., '29.

A series of experiments was carried out for the purpose of determining whether a light environment comprising radiations of comparatively long wave-length and only a small amount of energy was capable of affecting the chemical equilibrium of the blood as indicated by the calcium and inorganic phosphorus content of the blood of normal rabbits. A study was made of effects produced by prolonged exposure to fixed environmental conditions (neon light and darkness) as compared with a varying environment of diffuse, filtered sunlight and by a change from one environment to another.

It was found that the chemical equilibrium of the blood was definitely affected by the conditions employed and that the effects produced could be correlated with differences in organic constitution on the one hand, and

on the other, with certain differences in the functional activity of the same animals, involving nutrition and growth and the proliferative activity of hair follicles.

Kidney Radiation. A. Soiland, W. E. Costolow and O. N. Meland. Calif. & West. Med., 30:93-95, Feb., '29.

The authors have, for the past twenty years treated pathologic conditions of the kidney by irradiation, with benefit. They also report several cases of post-operative tuberculous sinus as being cured by radiation when other methods have failed. Radiation has superseded any other form of therapy in deep-seated tuberculous lesions. Spasm of the ureter has also been known to yield to x-ray exposures. The authors report a few cases of carcinoma of the kidney, treated by radiation, who are alive after two or three years and their condition greatly improved.

The Diagnosis and Treatment of Uterine Cancer. H. Schmitz. New England J. Med., 199:1149-1154, Dec., '28.

The frequency and preponderance of carcinomas of the female reproductive organs has been demonstrated by statistics. The observation has been discussed that the first stages of carcinoma of the uterine cervix do not cause symptoms and that nodules and ulcers are more often benign than malignant. When a cervical cancer causes symptoms then it probably has already progressed to an advanced stage. Hence the microscope must be used to diagnose malignant nodules and ulcers from similar benign conditions.

The pelvic examination of all recent mothers and the inclusion of pelvic examinations in periodic health examinations are the only means of detecting chronic inflammations of the cervix which should probably be treated whether they cause or do not cause symptoms. Chronic cervicitis is probably the period of advent of cervical carcinoma.

The influence of the extent of the growth and of the degree of the histological malignancy on the prognosis has been shown by statistics on five year good end-results. The indications for the various methods of treatment are based on the clinical grouping. The contra-indications for surgery have been given. The factors employed in radiation treatment have been briefly mentioned. The palliative treatment of the incurable stages have been described.

The Technic of Gall-Bladder Examinations. G. U. Pillmore. Am. J. Roentgenol., 20: 539-544, Dec., '28.

At full inspiration the gall-bladder usually moves downward and toward the midline of the body. The reverse is true at expiration. The greatest movement is in the tall, thin individual and the least in the thickest. This applies to either the standing or the prone position of the patient. There is a limitation of movement in

the presence of right sided intra thoracic and subdiaphragmatic irritations. In the type of gall-bladder occasionally found overlying the shadow of the spine, a complete expiration picture may throw the organ away from the spine sufficiently to determine more accurate information in regard to its contour. Inspiration and expiration pictures frequently aid in shifting the position of gas bubbles in the intestines from relationship with the shadow of the gall-bladder. A normal gall-bladder will frequently change its shape between inspiration and expiration because of the altered intra-abdominal pressure. Observation of this phenomenon tends to a conservative estimate of the presence of adhesions if only one preliminary film is made without regard to the phase of respiration. A gall-bladder will occasionally change its position with relation to the lower border of the liver between inspiration and expiration. It may be said when such a condition is observed that the gall-bladder is not firmly adherent throughout to the under surface of the liver. It is observed at complete expiration.

An inspiration picture of the gall-bladder usually places the organ away from the shadows of the ribs and calcifications that may exist in the costal cartilages. A solitary gallstone may change its position in the gall-bladder between full inspiration and complete expiration. The same may be true of a small collection of gallstones. This constant irritation during respiration may be a predisposing factor in primary malignancy of the gall-bladder. It may account for some of the limitation of deep breathing observed in an occasional chronic gallstone case and also for some of the induration in the gall-bladder wall.

It is rare for an inspiration and expiration picture to demonstrate the presence of adhesions between the gall-bladder and adjacent organs because the other viscera also move during respiration. There is more movement of the gall-bladder than of the kidneys in full respiration. This consideration may be utilized in differentiating kidney stone from gallstones. The liver and gall-bladder move a greater distance during respiration than the rest of the abdominal viscera. This is because the liver is a solid organ and fits snugly below the diaphragm and it is directly displaced as expansion of the lung takes place against the diaphragm. A better view of the liver is obtained at full inspiration. At inspiration in the normal asthenic type of individual, the posterior border of the liver moves downward more than the anterior border. This is because of the greater posterior deflection of the diaphragm and expansion of the lungs posteriorly.

The thickness of the abdomen varies between full inspiration and complete expiration so that it is necessary to vary the roentgenographic technic, the inspiration picture requiring greater penetration.

Osseous Changes in Hemolytic Isterus. L. G. Friedman. Am. J. Roentgenol., 20:440-444, Dec., '28.

Four cases of hemolytic icterus are presented. Only sufficient data are given to identify them as belonging

to this group. A resume of the prodromal features definitely characteristic are as follows: Insidious onset, chronicity, jaundice, splenomegaly, anemia, leukocytosis, atypical red cells, high icteric index, marked fragility, urobilinuria, osseous changes, and mongoloid facies.

The possibility that they were all congenital must be seriously considered. It is reasonable to assume that the crises were extremely mild during infancy, and were therefore, unnoticed. It is certain that the cranial and facial changes are more consistent with the congenital nature of this ailment and are definitely pathognomonic.

Technical Methods of Radium Application in Rectal Cancer. G. E. Binkley. Am. J. Roentgenol., 20:445-451, Dec., '28.

The favorable results obtained in the use of radium in cancer of the rectum are dependent on the choice of the methods of application and the proper technic in their use.

Interstitial irradiation by heavily filtered gold seeds and external irradiation by the element pack are the methods of choice, but high voltage roentgen rays may be substituted if sufficient radium is not available for external applications. Fishhook implanting needles permit more accurate placing of the gold seeds in certain types of tumors. Colostomy is necessary for proper implantation of the seeds in certain types of rectal cancer. Surgical measures combined with these methods of radium application are essential in certain cases, and the choice treatment is determined by the anatomy, type and extent of the lesions.

Radioactive Determination on Post-Mortem Specimens Taken from One Exposed to Radioactive Material Over a Prolonged Period. H. H. Barker. Am. J. Roentgenol. 21:31-37, Jan., '29.

The quantity of radio active material found in the body examined was hardly sufficient to produce the systemic changes which resulted in death. Any changes that occurred due to the effects of radium must have been accentuated by the inhalation of rather large quantities of emanation, the greater part of which was shortly excreted, or the exposure to the more penetrating type of gamma radiation from hermetically sealed preparation. Although it is known that the individual in question inhaled the emanation at various times and was exposed to the gamma radiation of rather high intensity, it is impossible to determine the amounts of either one of these exposures he received.

Endothermic Tonsillectomy. J. Blumberg. J. Med. Soc. N. J., 26:26-28, Jan., '29.

Statistics show that a high percentage of patients subjected to tonsillectomy suffer from hemorrhage and lung abscess. Any method which would remedy this condition would be very valuable. Endothermic tonsillectomy seems to be the method which meets these

requirements. The author has performed endothermic tonsillectomy in 110 cases and in no case did they encounter sloughing or hemorrhage. The author states that although technical knowledge of electricity is not essential, ordinary surgical judgement is necessary.

**Roentgenologic Study of the Inverted Cecum.
H. Fried. Am. J. Roentgenol., 20:531-538,
Dec., '28.**

The inverted cecum is a clinical entity; it has a symptom-complex both clinically and roentgenologically; the clinical signs and symptoms are fairly constant. The diagnosis can be established only by roentgenological study. In a normal or high-placed cecum the diagnosis may be established by the ingested barium meal. A high-placed cecum will turn back to its normal position when distended with a barium enema unless it is held back by adhesions as in Case III.

In a low-placed cecum an ingested barium meal will fail to show an inversion due to the crowding and massing of the intestines. In such cases, however, the barium enema will reveal the inversion because the floor of the pelvis prevents the organ from turning downward and the intraluminal pressure forces it to turn upward. The standing position will frequently turn the inverted cecum down while the prone position will turn it up. The recognition of inverted ceca is of prime clinical importance since it may prevent unnecessary abdominal operations.

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